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**A STUDY OF CONTEXTUAL FACTORS INFLUENCING
THE PERCEPTION OF VEGETABLES AMONG PRIMARY
SCHOOL CHILDREN**

IRENE A. BAXTER, Bsc. (Hons.)

**A thesis submitted in partial fulfilment of the requirements of the Open
University for the degree of Doctor of Philosophy (Sensory Science)**



**Queen Margaret University College
EDINBURGH**

Faculty of Business and Consumer Studies

August 2001

I declare that this thesis is the sole work of Irene A. Baxter.

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ABSTRACT

Low vegetable consumption among children, particularly in Scotland, is a cause for concern. Many factors may influence children's vegetable consumption, including contextual factors such as socio-economic status and city of residence. It is also likely that associated sensory properties influence children's perceptions of vegetables. The research presented in this thesis aimed to examine the influence of city of residence and socio-economic status on the vegetable perceptions and preferences of primary school children. The impact of the children's frequency of vegetable consumption on their perceptions and preferences was also investigated. In total, 23 children aged between 8-11-years-old participated in the pilot study, and 94 children aged between 8-10-years-old in the main study. The samples used in the main study (baked beans, tomatoes, carrots, cabbage, cauliflower, turnip, sweetcorn and peas) were all commonly consumed in Scotland and familiar to the subjects. Repertory grid method was used to obtain perceptual information of a free-choice nature relating to the vegetables, and additional hedonic data (without sample tasting) and contextual information was collected from each child. Data were principally analysed using generalised Procrustes analysis and internal preference mapping. Non-linear principal components analysis (PRINCALS) and homogeneity analysis (HOMALS) were employed to explore associations between children's perceptions of the vegetables and demographic variables. Finally, consensus data were obtained from the free-choice data and an extended internal preference map was constructed to examine correlations between perceptions and preferences for the vegetables. In conclusion, the children's preferences for and perceptions of the vegetables were influenced by socio-economic status, probably related to their experiences with/exposure to vegetables due to differences in the availability of different varieties between the socially disparate areas. Neither age, city of residence, gender, nor typical weekly consumption of vegetables were found to significantly influence the children's preferences or perceptions of the sample vegetables. The texture of the vegetables strongly influenced the children's perceptions and preferences of the sample vegetables. Despite the apparent influence of the samples' textural attributes, the flavour

of the vegetables (i.e. sweet versus bitter) was additionally responsible for sample likes/dislikes. Repertory grid was found to be a suitable method for children aged 8-years-old and above. It was also determined during the course of this thesis that children aged 8-years-old and older could successfully understand the concept of linear bipolar scales and could rank samples accordingly, both for their liking of the samples and for the intensity of particular descriptive attributes using such scales.

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CONTENTS

ACKNOWLEDGMENTS	4
CONTENTS	5
LIST OF TABLES	12
LIST OF FIGURES	15
GLOSSARY OF ABBREVIATIONS	17
CHAPTER ONE: INTRODUCTION	18
CHAPTER TWO: LITERATURE REVIEW	25
2.1 DIET AND DISEASE: THE ROLE OF FRUIT AND VEGETABLES	25
2.1.1 <i>The Importance of Fruit and Vegetable Consumption by Children</i>	26
2.1.2 <i>Dietary Recommendations for Fruit and Vegetable Consumption</i>	26
2.1.3 <i>The Antioxidant Theory</i>	27
2.1.4 <i>The Role of Fruit and Vegetables in the Prevention of Disease</i>	28
2.2 THE CONSUMPTION OF VEGETABLES IN THE UK	30
2.2.1 <i>Current Fruit and Vegetable Consumption in the UK</i>	30
2.2.2 <i>Fruit and Vegetable Consumption among Children and Adolescents</i>	31
2.2.3 <i>UK Fresh Vegetable Market</i>	32
2.2.4 <i>The Influence of Demographic Factors on Household Fresh Vegetable Consumption</i>	34
2.2.5 <i>Campaigns to Increase Fresh Vegetable Consumption</i>	35
2.2.6 <i>UK Frozen Vegetable Market</i>	37
2.2.7 <i>The Influence of Demographic Factors on Household Frozen Vegetable Consumption</i>	37
2.3 THE SCOTTISH VEGETABLE MARKET	38
2.3.1 <i>Regional Variations Within Scotland</i>	41
2.3.2 <i>Profile of Consumers in the Major Cities in Scotland: Vegetable Consumption</i>	41
2.3.2.1 <i>Edinburgh City (8.4% Scottish population)</i>	42
2.3.2.2 <i>Glasgow (13.3% Scottish population)</i>	43
2.3.3 <i>Comparing Glasgow Consumers to Edinburgh Consumers</i>	44
2.4 SCOTTISH CHILDREN'S CONSUMPTION OF VEGETABLES	45
	5

2.5 THE FACTORS AFFECTING FOOD ACCEPTANCE AND PREFERENCES IN CHILDREN	45
2.5.1 Food Choice Models	45
2.5.2 Sensory Factors	50
2.5.2.1 Innate Responses to Sensory Stimuli	50
2.5.2.2 Texture	51
2.5.2.3 Flavour	52
2.5.2.4 Snack-Food Flavoured Vegetables	54
2.5.2.5 Colour	55
2.5.2.6 Odour	56
2.5.3 Non-Sensory Factors	56
2.5.3.1 The Acquisition of Food Preferences in Childhood	56
2.5.3.2 Food Neophobia and Repeated Exposure Theory	57
2.5.3.3 Learned Aversions	57
2.5.3.4 Food Preferences and Consumption	58
2.5.3.5 Feeding Techniques	59
2.5.3.6 Social Context: Peer Modelling	60
2.5.3.7 Familial Influences	63
2.5.3.8 Changing food patterns	65
2.5.3.9 Socio-Economic Factors	66
2.6 OPPORTUNITIES TO INCREASE CHILDREN'S VEGETABLE CONSUMPTION	70
2.6.1 School Meal Provision	70
2.6.2 Food Advertising	72
2.7 AWARENESS AND MEASUREMENT OF THE PERCEPTION OF TEXTURE	73
2.7.1 Physiological	73
2.7.2 Consumer Awareness of Texture	74
2.7.3 Non-Sensory Methods of Texture Evaluation	75
2.7.4 Non-Oral Texture Evaluation	76
2.8 METHODOLOGY FOR ASSESSING SENSORY PERCEPTIONS OF PRODUCTS	76
2.8.1 Background	76
2.8.2 Quantitative Descriptive Analysis	77
2.8.3 Consumer Profiling Techniques	77
2.8.4 Free-Choice Profiling	78
2.8.5 Statistical Analysis of Sensory Data	79
2.9 USE OF SCALES WITH CHILDREN	80
2.9.1 Types of Scales	80
2.9.2 Scales commonly used with children	80
2.10 METHODS FOR OBTAINING PERCEPTUAL INFORMATION FROM CONSUMERS	82
2.10.1 Focus Groups	82

2.10.2	<i>Questionnaires</i>	82
2.10.3	<i>Sorting Techniques</i>	83
2.11	REPERTORY GRID METHOD	83
2.11.1	<i>Background</i>	83
2.11.1.1	Construct elicitation	84
2.11.1.2	Completing the grid	85
2.11.2	<i>The Use of Repertory Grid Method in Studies of Food Appropriateness</i>	85
2.11.3	<i>Use of Repertory Grid Method with Young Children</i>	86
2.11.4	<i>International Studies of Perceptions of Foods Using RGM</i>	87
CHAPTER THREE: RESEARCH OBJECTIVES AND PLAN OF EXPERIMENTATION		88
CHAPTER FOUR: METHODOLOGY		90
4.1	SUMMARY	90
4.2	PARTICIPATING SCHOOLS	90
4.2.1	<i>Selecting Schools on the Basis of Socio-Economic Status</i>	91
4.3	ASSESSORS	93
4.3.1	<i>Sampling of the assessors</i>	93
4.3.2	<i>Assessors Participating in the Pilot Study</i>	94
4.3.3	<i>Assessors Participating in the Main Study</i>	94
4.4	SAMPLES	95
4.4.1	<i>Samples (Vegetables) Used in the Pilot Study</i>	95
4.4.2	<i>Samples Used in the Main Study</i>	95
4.5	PROCEDURE FOR THE COLLECTION OF THE PERCEPTUAL DATA	96
4.5.1	<i>Repertory Grid Method to Elicit Constructs</i>	96
4.5.2	<i>Scoring of Personal Constructs</i>	97
4.6	ANALYSIS OF THE PERCEPTUAL DATA	98
4.6.1	<i>Background</i>	98
4.6.2	<i>The Theoretical Background to Generalised Procrustes Analysis</i>	98
4.6.2.1	The level-effect: Translation	99
4.6.2.2	The interpretation-effect: Rotation/Reflection	100
4.6.2.3	The range-effect: Isotropic scaling	100
4.6.3	<i>Use of Generalised Procrustes Analysis in the Interpretation of Perceptual Data</i>	101
4.6.4	<i>Discrepancies in the Assessors' Data Matrices</i>	101
4.7	QUANTITATIVE ANALYSIS OF THE IMPACT OF DEMOGRAPHIC VARIABLES ON THE PERCEPTIONS	102
4.7.1	<i>Background</i>	102
4.7.2	<i>The Theoretical Background to Principal Components Analysis by Alternating Least Squares</i>	102

4.7.3 Homogeneity Analysis by Alternating Least Squares	103
4.7.4. Principal Components Analysis	104
4.8 ANALYSIS OF THE HEDONIC DATA	105
4.8.1 Background	105
4.8.2 The Theoretical Background to Internal Preference Mapping	105
4.8.3 The Use of Internal Preference Mapping in the Interpretation of the Hedonic Data	106
4.8.4 Discrepancies in the Assessors' Hedonic Data Matrices	106
4.9 DEVELOPMENT OF THE QUESTIONNAIRE	106
4.9.1 Background	106
4.9.2 Piloting the Questionnaire	107
4.9.3 Questionnaire for the Main Study	108

CHAPTER FIVE: AN EVALUATION OF THE USE OF REPERTORY GRID METHOD TO ELICIT PERCEPTUAL DATA FROM PRIMARY SCHOOL CHILDREN: THE PILOT STUDY.

	109
5.1 INTRODUCTION	109
5.2 EXPERIMENTAL PROCEDURE	110
5.2.1 Assessors	110
5.2.2 Selection of the Vegetables	110
5.2.3 Repertory Grid Method	111
5.2.4 Scoring of Constructs	111
5.2.5 Treatment of the Data	111
5.3 RESULTS	112
5.3.1 Perceptions of the Vegetables	112
5.3.2 Self Reported Typical Weekly Vegetable Consumption	117
5.3.3 Preference Scores for Sample Vegetables	117
5.3.4 Suitability of Repertory Grid Method for use with Child Assessors	120
5.4 DISCUSSION	121
5.5 CONCLUSIONS	124

CHAPTER SIX: THE INFLUENCE OF CONTEXTUAL FACTORS ON PERCEPTIONS OF AND PREFERENCES FOR VEGETABLES AMONG EDINBURGH PRIMARY SCHOOL CHILDREN FROM SOCIALLY DISPARATE BACKGROUNDS.

6.1 INTRODUCTION	126
6.2 MATERIALS AND METHODS	127
6.2.1 Samples	127
6.2.2 Assessors	127

6.3 PROCEDURE	127
6.3.1 <i>Repertory Grid Method to Elicit Constructs</i>	127
6.3.2 <i>Scoring of Personal Constructs</i>	127
6.4 RESULTS	128
6.4.1 <i>Results of Generalised Procrustes Analysis</i>	128
6.4.2 <i>Self-Reported Vegetable Consumption</i>	137
6.4.3 <i>Results of the Analysis of the Preference Scores</i>	138
6.5 DISCUSSION	142
6.5.1 <i>Socio-Economic Status</i>	142
6.5.2 <i>Gender</i>	146
6.6 CONCLUSIONS	147

CHAPTER SEVEN: THE INFLUENCE OF CONTEXTUAL FACTORS ON PERCEPTIONS OF AND PREFERENCES FOR VEGETABLES AMONG GLASGOW PRIMARY SCHOOL CHILDREN FROM SOCIALLY DISPARATE BACKGROUNDS. 149

7.1 INTRODUCTION	149
7.2 MATERIALS AND METHODS	150
7.2.1 <i>Assessors</i>	150
7.2.2 <i>Samples</i>	151
7.2.3 <i>Procedure</i>	151
7.3 RESULTS	151
7.3.1 <i>Results of the Generalised Procrustes Analysis</i>	151
7.3.2 <i>Self-Reported Weekly Vegetable Consumption</i>	158
7.3.3 <i>Analysis of the Preference Scores</i>	159
7.4 DISCUSSION	165
7.4.1 <i>Socio-economic Status</i>	165
7.4.2 <i>Frequency of Vegetable Consumption</i>	167
7.4.3 <i>Gender and Frequency of Vegetable Consumption</i>	168
7.4.4 <i>Age of Assessors</i>	169
7.4.5 <i>Preferences</i>	169
7.5 CONCLUSIONS	170

CHAPTER EIGHT: THE ANALYSIS OF THE COMBINED DATA FROM THE FOUR SCHOOLS AND THE CONVERSION OF FREE-CHOICE DATA TO CONSENSUS DATA 172

8.1 INTRODUCTION	172
8.2 RESULTS	172
8.2.1 <i>Results after Generalised Procrustes Analysis</i>	172

8.2.2 <i>Preference scores</i>	180
8.3 THE NEED FOR FURTHER DATA ANALYSIS	184
8.4 NON-LINEAR PRINCIPAL COMPONENTS ANALYSIS	186
8.4.1 <i>The Application of PRINCALS to the Demographic Data</i>	186
8.5 RESULTS FROM PRINCALS	186
8.6 TRANSFORMING 'FREE-CHOICE' DATA INTO CONSENSUS DATA	189
8.6.1 <i>Cluster Analysis to Aid Selection of the Consensus Attributes</i>	189
8.6.2 <i>Principal Components Analysis of the Consensus Data</i>	191
8.7 HOMOGENEITY ANALYSIS OF THE INFLUENCE OF CONTEXTUAL VARIABLES ON THE CONSENSUS ATTRIBUTES	193
8.7.1 <i>Background</i>	193
8.7.2 <i>Results from Homogeneity Analysis</i>	193
8.8 MULTIVARIATE ANALYSIS OF VARIANCE OF THE CONTEXTUAL VARIABLES AND CONSENSUS ATTRIBUTES	200
8.9 FORMATION OF AN EXTENDED INTERNAL PREFERENCE MAP USING THE CONSENSUS DATA	201
8.9.1 <i>Further Analysis of the Hedonic Scores</i>	204
8.10 DISCUSSION	211
CHAPTER NINE: QUESTIONNAIRE ANALYSIS	216
9.1 INTRODUCTION	216
9.2 DESIGNING THE QUESTIONNAIRE	216
9.3 PILOTING THE QUESTIONNAIRE	218
9.4 RESULTS FROM THE ANALYSIS OF THE PILOT QUESTIONNAIRE	218
9.4.1 <i>Self-Reported Frequency of Vegetable Consumption</i>	218
9.4.2 <i>Vegetable Likes / Dislikes</i>	219
9.4.3 <i>The Importance of School Meals to Overall Vegetable Consumption</i>	219
9.4.4 <i>Familiarity with a Range of Vegetables</i>	220
9.5 ALTERATIONS TO THE QUESTIONNAIRE PRIOR TO THE MAIN STUDY	221
9.6 RESULTS FROM THE ANALYSIS OF THE QUESTIONNAIRE FROM THE MAIN STUDY	223
9.6.1 <i>Self-Reported Weekly Vegetable Consumption</i>	223
9.6.2 <i>Vegetable Likes / Dislikes</i>	225
9.6.3 <i>Consumption of Vegetables at Home and at School</i>	229
9.6.4 <i>Familiarity with the Sample Vegetables</i>	230
9.6.5 <i>Liking of the Sample Vegetables</i>	232
9.6.6 <i>Shops Used by the Assessors' Family to Purchase Vegetables</i>	233
9.7 OVERALL COMMENTS ON THE QUESTIONNAIRE	240

CHAPTER TEN: DISCUSSION	242
10.1 INTRODUCTION	242
10.2 ADVANTAGES/DISADVANTAGES OF RGM COMPARED TO OTHER POSSIBLE METHODS OF DATA COLLECTION.	243
10.3 ADVANTAGES/DISADVANTAGES OF FREE CHOICE OVER CONSENSUS DATA.	247
10.4 USE OF RATING SCALES WITH CHILD ASSESSORS.	249
10.5 CHILDREN’S PERCEPTIONS/PREFERENCES OF VEGETABLES	250
10.6 INFLUENCE OF SOCIO-ECONOMIC STATUS ON CHILDREN’S PERCEPTIONS OF AND PREFERENCES FOR VEGETABLES	255
10.7 INFLUENCE OF GEOGRAPHY ON CHILDREN’S PERCEPTIONS/PREFERENCES OF VEGETABLES	258
10.8 INFLUENCE OF GENDER ON CHILDREN’S PERCEPTIONS/PREFERENCES OF VEGETABLES	259
10.9 INFLUENCE OF AGE ON CHILDREN’S PERCEPTIONS/PREFERENCES OF VEGETABLES	260
10.10 INFLUENCE OF FREQUENCY OF VEGETABLE CONSUMPTION ON CHILDREN’S PERCEPTIONS/PREFERENCES OF VEGETABLES	261
10.11 SUMMATION OF THE FINDINGS OF THIS RESEARCH	263
10.12 LIMITATIONS OF THIS RESEARCH	265
10.13 STRATEGIES TO INCREASE VEGETABLE CONSUMPTION	265
10.14 SUGGESTIONS FOR FURTHER RESEARCH	269
REFERENCES	271

List of Tables

TABLE 2.1: THE INFLUENCE OF GEOGRAPHIC AND DEMOGRAPHIC FACTORS ON THE RATIO OF VITAMIN E CONCENTRATION TO SERUM CHOLESTEROL LEVELS	29
TABLE 2.2: CONSUMPTION FOR VEGETABLES BY INCOME GROUP, 1995 ^(A) AND 1996	31
TABLE 2.4: CONSUMPTION OF FRESH VEGETABLES BY REGION, 1995 (IN BRACKETS) AND 1996	35
TABLE 2.5: SCOTTISH CONSUMPTION OF VEGETABLES COMPARED TO THE UK AVERAGE	40
TABLE 2.6: REGIONAL VEGETABLE PURCHASING PROFILES COMPARED TO THE SCOTTISH AVERAGE	41
TABLE 5.1: CHILDREN'S ATTRIBUTES HAVING CORRELATION COEFFICIENTS OF ≥ 0.70 FOR DIMENSIONS 1-3.	113
TABLE 5.2: MEAN HEDONIC SCORES FOR THE SAMPLE VEGETABLES	119
TABLE 6.1: EDINBURGH ASSESSORS' ATTRIBUTES WITH CORRELATION COEFFICIENTS OF ≥ 0.65 FOR DIMENSIONS 1 TO 5	129
TABLE 6.2: TOTAL (CONSENSUS) AND RESIDUAL VARIANCE FOR DIMENSIONS 1 TO 4 DISTRIBUTED ACROSS THE EIGHT SAMPLES.	132
TABLE 6.3: REPORTED WEEKLY VEGETABLE CONSUMPTION BY SOCIO-ECONOMIC STATUS (SES)	137
TABLE 6.4: FRIEDMAN TWO-WAY ANOVA RESULTS ($P < 0.001$) FROM THE EDINBURGH STUDY.	140
TABLE 6.5: RESULTS OF MANN-WHITNEY TESTS ON PREFERENCE SCORES BY SOCIO-ECONOMIC STATUS (SES).	141
TABLE 7.1: CHILDREN'S ATTRIBUTES WITH CORRELATION COEFFICIENTS OF ≥ 0.65 FOR DIMENSIONS 1 TO 4.	152
TABLE 7.2: RESIDUAL AND TOTAL (CONSENSUS) VARIANCE FOR DIMENSIONS 1 TO 4 DISTRIBUTED ACROSS THE SAMPLES.	157
TABLE 7.3: CHI-SQUARE ANALYSIS ($P < 0.001$) OF THE FREQUENCY OF WEEKLY VEGETABLE CONSUMPTION BY SOCIO-ECONOMIC STATUS	159
TABLE 7.4: FRIEDMAN TWO-WAY ANOVA RESULTS ($P < 0.001$) FROM THE GLASGOW STUDY.	162
TABLE 7.5: MANN-WHITNEY TESTS FOR THE EFFECT OF SOCIO-ECONOMIC STATUS ON PREFERENCES FOR THE VEGETABLES	163
TABLE 7.6: MANN-WHITNEY TESTS FOR THE EFFECT OF GENDER ON PREFERENCES FOR THE VEGETABLES	164
TABLE 8.1: ASSESSORS' DESCRIPTORS HAVING AN ABSOLUTE CORRELATION OF ≥ 0.65 WITH THE FIRST FOUR DIMENSIONS OF THE SAMPLES SPACE RESULTING FROM GPA OF THE DATA.	173
TABLE 8.2: SUMMARY OF MULTIPLE POINTS IN FIGURE 8.10 ALLOWING IDENTIFICATION OF THE CASES.	188
TABLE 8.3: SELECTED CONSENSUS ATTRIBUTES AND OTHER ATTRIBUTES SHOWN BY CLUSTER ANALYSIS TO BE USED IN A SIMILAR MANNER BY THE ASSESSORS.	191

TABLE 8.4: MEMBERSHIP OF THE CLUSTERS OF NON-TEXTURAL CONSENSUS ATTRIBUTES ALONG DIMENSION 1 OF FIGURE 8.15.	199
TABLE 8.5: CONSENSUS ATTRIBUTES HAVING SIGNIFICANT INTERACTIONS (FROM MANOVA) WITH THE CONTEXTUAL VARIABLES.	200
TABLE 8.6: PEARSON CORRELATION COEFFICIENTS FOR CONSENSUS ATTRIBUTES WITH THE FIRST THREE PREFERENCE DIMENSIONS.	203
TABLE 8.7: RESULTS OF FRIEDMAN TWO-WAY ANOVA ($p < 0.001$) OF HEDONIC SCORES FOR ALL ASSESSORS.	205
TABLE 8.8: EFFECT OF FREQUENCY OF VEGETABLE CONSUMPTION ON PREFERENCE: RESULTS OF MANN-WHITNEY.	206
TABLE 8.9: EFFECT OF GENDER ON PREFERENCE: RESULTS OF MANN-WHITNEY TESTS.	207
TABLE 8.10: EFFECT OF CITY OF RESIDENCE ON PREFERENCE: RESULTS OF MANN-WHITNEY TESTS.	208
TABLE 8.11: EFFECT OF SES ON PREFERENCE: RESULTS OF MANN-WHITNEY TESTS.	209
TABLE 8.12: EFFECT OF AGE ON PREFERENCE: RESULTS OF MANN-WHITNEY TESTS.	210
TABLE 9.1: FAMILIARITY OF THE CHILDREN PARTICIPATING IN THE PILOT QUESTIONNAIRE WITH ELEVEN COMMON VEGETABLES.	220
TABLE 9.2: SELF-REPORTED FREQUENCY OF VEGETABLE CONSUMPTION (WEEKLY) AMONG THE MAIN STUDY PARTICIPANTS	223
TABLE 9.3: EFFECT OF CITY OF RESIDENCE ON SELF-REPORTED FREQUENCY OF VEGETABLE CONSUMPTION (WEEKLY).	224
TABLE 9.4: EFFECT OF SOCIO-ECONOMIC STATUS ON SELF-REPORTED WEEKLY FREQUENCY OF VEGETABLE CONSUMPTION.	224
TABLE 9.5: EFFECT OF GENDER ON SELF-REPORTED WEEKLY FREQUENCY OF VEGETABLE CONSUMPTION.	225
TABLE 9.6: EFFECT OF THE ASSESSORS' AGE ON SELF-REPORTED WEEKLY FREQUENCY OF VEGETABLE CONSUMPTION.	225
TABLE 9.7: THE VEGETABLE PREFERENCES OF PRIMARY-SCHOOL CHILDREN.	226
TABLE 9.8: REASONS GIVEN BY PRIMARY-SCHOOL CHILDREN FOR THEIR VEGETABLE PREFERENCES	226
TABLE 9.9: THE LEAST LIKED VEGETABLE AMONG PRIMARY-SCHOOL CHILDREN.	228
TABLE 9.10: REASONS GIVEN BY PRIMARY-SCHOOL CHILDREN FOR THEIR VEGETABLE DISLIKES.	229
TABLE 9.11: PREVIOUS EXPOSURE TO AND FAMILIARITY WITH THE SAMPLE VEGETABLES	231
TABLE 9.12: CHILDREN'S LIKING AND DISLIKING FOR THE SAMPLE VEGETABLES.	232
TABLE 9.13: SHOPS USED BY THE FAMILIES OF THE CHILDREN TO PURCHASE VEGETABLES	234
9.6.7 SUITABILITY OF SAMPLE VEGETABLES FOR EATING WITH COMMONLY AVAILABLE FOODS	235
TABLE 9.14: SUITABILITY OF THE SAMPLE VEGETABLES FOR EATING WITH A 'FRY-UP' (I.E. ANY COMBINATION OF FRIED SAUSAGE, BACON, EGG & CHIPS).	235
TABLE 9.15: SUITABILITY OF THE SAMPLE VEGETABLES FOR EATING WITH BURGERS	236

TABLE 9.16: SUITABILITY OF THE SAMPLE VEGETABLES FOR EATING WITH RED MEAT	237
(I.E PORK, HAM, BEEF, LAMB)	237
TABLE 9.17: SUITABILITY OF SAMPLE VEGETABLES FOR EATING IN SOUP	237
TABLE 9.18: SUITABILITY OF THE SAMPLE VEGETABLES FOR EATING WITH STEW	238
TABLE 9.19: SUITABILITY OF THE SAMPLE VEGETABLES FOR EATING WITH PIES	239
TABLE 9.20: SUITABILITY OF THE SAMPLE VEGETABLES FOR EATING WITH FISH	239
TABLE 9.21: SUITABILITY OF THE SAMPLE VEGETABLES FOR EATING WITH A COOKED BREAKFAST	240

List of Figures

FIGURE 2.1: SOME FACTORS AFFECTING FOOD CHOICE AND INTAKE (TAKEN FROM SHEPHERD, 1985).	47
FIGURE 2.2: MODEL OF THE FISHBEIN AND AJZEN THEORY OF REASONED ACTION.	49
FIGURE 5.1: DIMENSION 1 (42%) AND DIMENSION 2 (19%) OF THE SAMPLE CONSENSUS SPACE.	114
FIGURE 5.2: DIMENSION 2 (19%) AND DIMENSION 3 (12%) OF THE SAMPLE CONSENSUS SPACE.	116
FIGURE 5.3: INTERNAL ANALYSIS ON HEDONIC SCORES OF ASSESSORS WHO ARE FITTED ON PREFERENCE DIMENSIONS 1 AND 2.	118
FIGURE 5.4: ASSESSOR PLOT DERIVED FROM GPA OF FREE-CHOICE PROFILE DATA	120
FIGURE 6.1: ASSESSOR PLOT DERIVED FROM GPA OF FREE-CHOICE PROFILE DATA. SETS 1 TO 25 ARE THE DISADVANTAGED ASSESSORS, SETS 26-49 ARE THE ADVANTAGED ASSESSORS.	130
FIGURE 6.2: DIMENSION 1 (31%) AND DIMENSION 2 (19%) OF THE SAMPLE CONSENSUS SPACE.	131
FIGURE 6.3: DIMENSION 3 (16%) AND DIMENSION 4 (14%) OF THE SAMPLE CONSENSUS SPACE.	134
FIGURE 6.4: DIMENSION 4 (14%) AND DIMENSION 5 (8%) OF THE SAMPLE CONSENSUS SPACE.	136
FIGURE 6.5: INTERNAL ANALYSIS ON VEGETABLE ACCEPTANCE SCORES OF ASSESSORS WHO ARE SIGNIFICANTLY FITTED ON PREFERENCE DIMENSIONS 1 AND 2.	139
FIGURE 7.1: ASSESSOR PLOT OF GLASGOW CHILDREN. SETS 1 TO 22 ARE THE ADVANTAGED ASSESSORS, SETS 23 TO 42 ARE THE DISADVANTAGED ASSESSORS.	153
FIGURE 7.2: DIMENSION 1 (33%) AND DIMENSION 2 (18%) OF THE SAMPLE CONSENSUS SPACE.	155
FIGURE 7.3: DIMENSION 3 (15%) AND DIMENSION 4 (14%) OF THE SAMPLE CONSENSUS SPACE.	158
FIGURE 8.1: ASSESSOR PLOT DERIVED FROM GPA OF FREE-CHOICE DATA FROM ALL CHILDREN:	174
FIGURE 8.2: DIMENSION 1 (31%) AND DIMENSION 2 (18%) OF THE SAMPLE CONSENSUS SPACE BASED ON THE DATA FROM THE CHILDREN AT ALL FOUR PARTICIPATING SCOTTISH SCHOOLS.	176
FIGURE 8.3: DIMENSION 3 (15%) AND DIMENSION 4 (15%) OF THE CONSENSUS SAMPLE SPACE.	177
FIGURE 8.4: DIMENSION 4 (15%) AND DIMENSION 5 (8%) OF THE CONSENSUS SAMPLE SPACE.	179
FIGURE 8.5: INTERNAL ANALYSIS ON VEGETABLE ACCEPTANCE SCORES OF ASSESSORS WHO ARE SIGNIFICANTLY FITTED ON PREFERENCE DIMENSIONS 1 AND 2, SEPARATED BY SCHOOL.	180
FIGURE 8.6: INTERNAL ANALYSIS ON VEGETABLE ACCEPTANCE SCORES OF ASSESSORS WHO ARE SIGNIFICANTLY FITTED ON PREFERENCE DIMENSIONS 1 AND 2, SEPARATED BY GENDER.	181
FIGURE 8.7: INTERNAL ANALYSIS ON VEGETABLE ACCEPTANCE SCORES OF ASSESSORS WHO ARE SIGNIFICANTLY FITTED ON PREFERENCE DIMENSIONS 1 AND 2, SEPARATED BY AGE.	182
FIGURE 8.9: CATEGORY CO-ORDINATES PLOT SHOWING QUANTIFICATIONS FOR ALL VARIABLES.	187
FIGURE 8.10: PRINCIPAL COMPONENTS ANALYSIS PLOT FOR THE CONSENSUS DATA SET.	192
FIGURE 8.11: PLOT OF THE DISCRIMINATION MEASURES FOR THE CONSENSUS ATTRIBUTES.	194
	15

FIGURE 8.12: PLOT OF THE DISCRIMINATION MEASURES FOR THE CONTEXTUAL VARIABLES. 195

FIGURE 8.13: INFLUENCE OF CONTEXTUAL VARIABLES AND SAMPLES ON THE CHILDREN’S PERCEPTIONS OF THE TEXTURE OF THE VEGETABLES. 196

FIGURE 8.14: INFLUENCE OF CONTEXTUAL VARIABLES ON THE CHILDREN’S PERCEPTIONS OF THE TEXTURE OF THE VEGETABLES (EXCLUDING THE SAMPLES FROM THE ANALYSIS). 197

FIGURE 8.15: INFLUENCE OF CONTEXTUAL VARIABLES ON THE CHILDREN’S PERCEPTIONS OF THE NON-TEXTURAL CHARACTERISTICS OF THE VEGETABLES (EXCLUDING THE SAMPLES FROM THE ANALYSIS). 198

FIGURE 8.16: PERCEPTUAL ATTRIBUTES PROJECTED ONTO THE INTERNAL PREFERENCE MAP OF THOSE ASSESSORS SIGNIFICANTLY CORRELATED WITH PREFERENCE DIMENSIONS 1 AND 2. 204

GLOSSARY OF ABBREVIATIONS

DEPCAT – Deprivation category

FCP – Free choice profiling

GPA – Generalised Procrustes analysis

HOMALS – Homogeneity analysis by alternating least squares

HVC – High vegetable consumers (eats vegetables 4 times per week)

IGD – Institute of Grocery Distribution

LVC – Low vegetable consumer (eats vegetables < 4 times per week)

MAFF – Ministry of Agriculture, Fisheries and Food.

PCA – Principal components analysis

PRINCALS – Principal components analysis by alternating least squares

RGM – Repertory grid method

SES –Social economic status

US and USA –United States of America

CHAPTER ONE: INTRODUCTION

The importance of establishing a healthy diet early in childhood has recently been emphasised by the Health Education Authority (Health Education Authority, 1995). This is because a poor diet in childhood has been suggested to be the origin of many diet-related diseases (e.g. coronary heart disease, some cancers, cerebrovascular diseases and diabetes mellitus). Eating habits in one's early years may well establish a dietary pattern which is difficult to alter once adulthood is reached.

Overall, a "healthy" diet is one that is low in both fat and refined sugars, high in fibre, and contains sufficient fruits and vegetables (Scottish Office Home and Health Department (SOHHD), 1993). This type of diet is the basis of the "Mediterranean Diet", associated with the countries in this area, the populations of which have been found to have low incidences of diet-related diseases (Sacks, 1998; WHO, 1982). Dietary targets have been set, by the World Health Organisation (WHO, 1990) and by the Scottish Office (SOHHD, 1993) in a bid to reduce incidences of diseases linked to poor nutrition. *The Health of the Nation* (Department of Health, 1992) did not set a dietary target for residents of England and Wales, instead advising an overall increase in the intake of fruit and vegetables. More recent publications such as *Saving Lives: Our Healthier Nation* (Department of Health, 1999) follow this tack of recommending a diet with plentiful fruit and vegetables without actually suggesting the amount to be eaten.

In the UK, a typical diet contains an excessive amount of fat and refined sugar, too little fibre and insufficient fruit and vegetables (MAFF, 1998). Throughout the UK there are regional and national disparities in the diet, with the Scottish population consuming a very poor diet, with particularly low intakes of fruit and vegetables (MAFF, 1998; SOHHD, 1993). Fruit and vegetables are believed to contain certain antioxidants that play a protective role in the prevention of many diet-related diseases (National Heart Forum, 1997). The consumption of sufficient fruit and vegetables is therefore an

important issue. Recommendations for everyone over the age of two years old to be consuming five portions of fruit and vegetables per day have been issued by the government (SOHHD, 1993), trade bodies and the multiple retailers (Retail Business, 1997 part 2; Cathro *et al.*, 1995).

Research has shown that many Scottish children consume very little (if any) fruit and vegetables compared to children in other areas of the UK (Wrieden, 1996; Anderson *et al.*, 1994a; Department of Health, 1989). Low vegetable consumption is a particular problem (Marshall *et al.*, 1994). Possible reasons for children's low consumption of vegetables could include the sensory properties of vegetables. Their inherent properties (i.e. the appearance, aroma, taste and texture) may be off-putting to children and consequently inhibit their consumption (Baxter and Schröder, 1997). In particular, the texture of cooked vegetables compared to raw is markedly different. Research in the USA during the 1960's and 1970's (Szczesniak and Kleyn, 1963; Szczesniak and Kahn, 1971; Szczesniak 1971 and 1972) suggested that consumers were very aware of food textures, and that children frequently disliked textures such as 'soggy' and 'stringy' which were associated with cooked vegetables.

Recent research has found that children's preferences for vegetables are reliable predictors of their actual consumption (Domel *et al.*, 1996). In earlier research, Domel *et al.* (1993b) found that the preparation method was crucial in determining children's willingness to consume vegetables. Behavioural models that try to predict our actions, e.g. the theory of reasoned action (Fishbein and Ajzen, 1975; Ajzen and Fishbein, 1980) and the theory of planned behaviour (Ajzen, 1991), suggest that our attitudes are more reliable predictors of our actions when they are measured as close to the intended action as possible (e.g. food preferences measured prior to the food being offered/eaten). Such behavioural models and models of food choice (e.g. Shepherd, 1985) show that many factors besides preferences are influential in determining our food consumption. For example, sensory factors, economic and social factors and physiological factors are just some of the determinants of our food intake. Many of the influences on children's food

choice have previously been researched (as reviewed by Birch *et al.*, 1996) and could be used to provide explanations for children's (un)willingness to consume vegetables. However, there still remains a lack of knowledge as to how children's perceptions of vegetables and their sensory characteristics influence their consumption.

Non-sensory factors are also likely to be responsible for the low vegetable consumption prevalent among Scottish children. When introduced to unfamiliar foods, children (and adults) often display neophobia (fear of novel situations) which inhibits consumption (Rozin, 1982).

Parental attitudes towards foods also influence their children's preferences (Rozin *et al.*, 1984). Parents who consume few (if any) vegetables are, probably unconsciously, suggesting to their children that vegetables are unpleasant. At the least they are limiting their children's opportunities to experience a wide variety of vegetables and perhaps find varieties that they like. Ideally, for a child to overcome any unwillingness to taste a new or disliked food, they need to taste it at least ten times (Sullivan and Birch, 1990). This may be extremely difficult for parents to put into practice. More commonly perhaps, parents resort to the use of coercion or bribery to get children to eat vegetables, a practice which may have the opposite effect to that desired (Birch *et al.*, 1995).

Other social influences on children's food preferences include the food preferences of respected others (Birch *et al.*, 1980), and exposure to 'target foods' (both visual and actual tasting) that reduces neophobia and increases actual preferences (Pliner, 1982; Birch and Marlin, 1982; Birch *et al.*, 1987).

Environmental factors have been found to influence children's consumption of vegetables (Baxter and Schröder, 1997), with socio-economic status being particularly important. Earlier research has demonstrated that families of lower socio-economic status consume less vegetables than those of higher socio-economic status (MAFF, 1998; Shepherd *et al.*, 1996; SOHHD, 1993; Leather, 1993), probably due to low income and limited access to

good quality, inexpensive produce for low socio-economic status consumers (Anderson *et al.*, 1996; Leather, 1993).

Eating trends, in particular the relatively recent increase in snacking among Scottish children (Anderson *et al.*, 1993; Ruxton *et al.*, 1996), potentially limit the consumption of most vegetables, as the popularity of the main meal based on 'meat and two veg' goes into decline. This is despite the year-round availability of a wide selection of traditionally 'seasonal' produce and the convenience of prepared pre-packed vegetables (EIU Retail Business, 1995) which theoretically should make it easier to consume adequate quantities of vegetables.

Cultural norms strongly influence children's acceptance of what are desirable foods and what are not (Birch, 1995). Traditionally the Scottish populace consumed a diet which consisted of vegetables well suited to use in soups and stews, such as kale, turnips and other root vegetables (Steven, 1985). These dishes are appropriate for the colder climate of Scotland, but such cooking methods often result in vegetables with textures that, according to Szczesniak's research, are unappealing to children. The Scottish climate was recently cited as one reason for low consumption of vegetables (Anderson *et al.*, 1994c), with people preferring to eat 'comfort foods' (e.g. cakes, pastries, confectionery) when the weather is unpleasant. The vegetable consumption of the Scottish consumer is further hampered by a dislike for the taste of vegetables by the individual or their family and a lack of skills/knowledge with regard to vegetable preparation (Marshall *et al.*, 1994).

Advertising is another environmental factor that influences children's food requests (Donkin *et al.*, 1993) and possibly contributes to their unwillingness to eat vegetables. Advertising spends on snack food products far exceed the budgets available for the promotion of fruit and vegetables (Leather, 1995), so that these 'unhealthy' foods are probably perceived by children to be more desirable than fruit and vegetables.

Schools, in collaboration with parents, have the ability to promote and facilitate sufficient

fruit and vegetables consumption among pupils (Scottish Office Department of Health (SODoH), 1996). School meals are an important vehicle for increasing children's vegetable consumption, especially in areas of social deprivation. However, as of yet there are no formal requirements for service providers to address the issues raised in the Scottish Diet Report (SOHHD, 1993). However, the Diet Action Plan for Scotland (SODoH, 1996) does make recommendations for schools to intervene and promote a healthier diet among pupils.

Intervention studies conducted by researchers have attempted to increase fruit and vegetables consumption among target populations (e.g. low vegetable consumers, children). Children's fruit and vegetables consumption has been targeted in intervention studies in recent years (Boaz and Ziebland, 1998; Boaz *et al.*, 1998; Cathro *et al.*, 1995; Horne *et al.*, 1998). An intervention study in the USA to try to increase children's fruit and vegetables consumption reported difficulty increasing both the subjects' vegetable preferences and their actual consumption (Domel *et al.*, 1993a).

An examination of the sensory literature suggested that studies with children were usually limited to preference testing and employed hedonic scales (often pictorial 'smiley faces') to record these preferences (e.g. Chen *et al.*, 1996; Kimmel *et al.*, 1994; Kroll, 1990; Birch *et al.*, 1990, Fallon *et al.*, 1984). In 1994, Moskowitz reported that children aged eight years and over could use linear rating scales that were anchored at either end. This widens the range of sensory techniques that theoretically could be used with child assessors, allowing researchers to obtain more detailed quantitative data from such studies.

The thesis that is presented here examines Scottish children's perceptions of vegetables, concentrating on their sensory properties, in particular the texture. To obtain both descriptive and quantitative data, Kelly's (Kelly, 1955) repertory grid method (RGM) was thought to be a potentially suitable method. RGM is used to elicit assessors' personal constructs pertaining to a set of samples and then to obtain their sample scores for these

constructs. RGM has previously been employed to examine consumers' perceptions of a variety of foods, e.g. meat (McEwan, 1988; Thomson and McEwan, 1988), confectionery (McEwan, 1988; McEwan *et al.*, 1989), alcoholic beverages (Scriven *et al.*, 1989; Gains and Thomson, 1990; Piggott and Watson, 1992), milk (Raats and Shepherd, 1991/2), cheese (Jack *et al.*, 1994) and fruit (Jack *et al.*, 1998; Jack *et al.*, 1997). In the UK, the use of RGM with child assessors had been limited to clinical psychology studies (e.g. Ravenette, 1975; Salmon, 1976; Fransella and Bannister, 1977; Edwards, 1988). In Australia, Worsley (1980) had used RGM to examine adolescents' perceptions of foods, including eight different fruit and vegetables, but this was not a detailed study. Australian primary school children's perceptions of a range of foods (including a few fruit and vegetables) were later examined using consensus matrices devised by the authors (Worsley *et al.*, 1984), although this was not strictly speaking RGM.

This research examines the suitability of RGM as a method to elicit primary school children's perceptions of vegetables. Additionally, preference data were collected from the children that subsequently could be correlated to their perceptual data. To investigate the influence of socio-economic status on children's perceptions and vegetable consumption, schools in socially disparate areas of the selected cities were chosen. The impact of geographical factors upon vegetable consumption was investigated during this research by selecting schools in Glasgow (west coast) and Edinburgh (east coast of Scotland). These two cities were of particular interest because of the considerable differences between their residents' vegetable consumption (IGD, 1995; Tunstall-Pedoe, 1989).

It was hoped that the information collected from this research could inform future campaigns to promote vegetable consumption among Scottish children. By focusing on the aspects of common vegetables that children find appealing, and being aware of characteristics which are off-putting, such campaigns might be made more effective. Additionally, it was hoped that such information would be of interest to those responsible for the production of school meals. Furthermore, information on children's perceptions of

the sensory properties of vegetables might be of use to parents as well as food manufacturers, in providing pointers for recipe formulations and preparation methods.

CHAPTER TWO: LITERATURE REVIEW

2.1 Diet and Disease: The Role of Fruit and Vegetables

Diets that are high in fruit and vegetables, in particular green and yellow vegetables and citrus fruits, are associated with reduced incidences of cancers of the lung, colon, bladder, oesophagus, and stomach (SOHHD, 1993). High intakes of fat are linked to cancers of the breast, colon, prostate and rectum (SOHHD, 1993). The diets associated with Mediterranean countries include high fruit and vegetable intakes and low fat consumption (the so-called 'Mediterranean Diet'). Epidemiological studies suggest that populations that consume the Mediterranean diet have low incidences of many diet-related diseases (Sacks, 1998; WHO, 1982).

Scotland has the highest premature mortality rates in Western Europe from diet-related diseases such as coronary heart disease, stroke and cancer (SOHHD, 1993). Scottish women in particular are more likely to die early from such diseases as compared to women from other Western societies. In 1989, Scotland had the highest premature coronary mortality rate of any other country in the world, linked to the typical Scottish high-fat, high-sugar diet (SOHHD, 1993). A recent WHO press release (WHO, 1999) showed that of the countries with high male coronary mortality rates, regions within Finland, Sweden and Australia are making the best progress at reducing incidences of heart disease because of dietary change while Scotland appears to be one of the countries where incidences of coronary heart disease remain elevated.

High blood pressure is common among middle-aged Scots, so it is no surprise that the national rate for strokes is also one of the highest in the Western world. Lung, breast and colon cancers are also prevalent in Scotland, with low fruit and vegetable consumption being especially related to the latter. Over half of middle-aged Scots are overweight, which can be associated with an increased risk of developing coronary heart disease, cancers, stroke or diabetes mellitus (SOHHD, 1993). A diet that is typically low in fruit

and vegetables and high in saturated fat consumption has had a detrimental effect upon the health of the Scottish population.

2.1.1 The Importance of Fruit and Vegetable Consumption by Children

Childhood is an ideal time to establish the recommended dietary patterns that research shows can reduce the risk of developing the major fatal diseases which afflict Western society (Health Education Authority, 1995; SOHHD, 1993; The Caroline Walker Trust, 1992). Unfortunately, it has been suggested that the diet consumed by many Scottish children is one which can be expected to promote the development of such chronic diseases in adulthood (SOHHD, 1993). The consumption of sufficient amounts of fruit and vegetables is just one key element of a healthy diet. However, the Scottish population is known to have particularly low levels of fruit and vegetable consumption (MAFF, 1998 and 1997). Even though fruit consumption in Scotland is increasing, the average fruit and vegetables intake remains below WHO recommendations, and declining vegetable intake levels are a cause for concern (IGD, 1998; Marshall *et al.*, 1994).

2.1.2 Dietary Recommendations for Fruit and Vegetable Consumption

The National Heart Forum (1997a) recently suggested that there is a good indication that consuming a sufficient quantity of a range of fruit and vegetables is beneficial to health and reduces one's risk of coronary heart disease. The suggestion that fruit and vegetables may play an important role in the prevention of cancer and coronary heart disease was also strongly emphasised in a report from the US National Academy of Sciences (NAS) (NAS Committee on Diet, Nutrition and Cancer, 1982). NAS were the first to recommend an increase in fruit and vegetables consumption based on their inherent properties, rather than just as a substitute for fatty food (National Heart Forum, 1997a). In 1982, the WHO recommended an increased fruit and vegetables consumption to mimic the diet in Mediterranean countries where the coronary heart disease mortality rate was low (WHO, 1982).

Later, government bodies and health agencies quantified the amount of fruit and vegetables that needs to be consumed to have a protective effect against these aforementioned chronic diseases. In the US, the National Research Council (NRC) recommended at least five daily servings of a combination of fruit and vegetables (NRC, 1989). A WHO Committee (WHO, 1990) suggested that a minimum daily intake of 400g of fruit and vegetables for adults was necessary to protect against cancer and coronary heart disease. In the UK, the government produced the *Health of the Nation* plan (Department of Health, 1992) which recommended an overall increase in fruit and vegetable consumption, but did not set an actual intake target. Dietary targets were set for the Scottish population in the Scottish Office Home and Health Department's (SOHHD) report '*The Scottish Diet*'. This report recommended 400g per day of fruit and vegetables; equivalent to 5 portions for an adult (SOHHD, 1993). Additionally, *The Scottish Diet* report set a target to have all children over the age of two years consuming 3-4 portions of fruit and vegetables per day by the year 2005. Incidentally, children under two years of age may not obtain sufficient quantities of other necessary nutrients (i.e. energy, protein, fat) from their diet if they also eat 3-4 portions of fruit and vegetables per day, assuming that such a high fruit and vegetable intake would be to the exclusion of other foods. The 1994 COMA report, '*Nutritional Aspects of Cardiovascular Disease*', having examined the role of antioxidants in the protection against coronary heart disease, suggested a 50% increase in UK fruit and vegetables consumption, along with its other dietary guidelines (Department of Health, 1994).

In the UK, government-funded health literature has mentioned the role of antioxidants in the protection against coronary heart disease and cancers (e.g. Department of Health, 1994). So what scientific evidence is available to corroborate the link between fruit and vegetables consumption, antioxidants and protection against these diseases?

2.1.3 The Antioxidant Theory

Free radicals (highly reactive and unstable atoms or molecules) in the body have been found to cause tissue damage linked to the development of coronary heart disease

(National Heart Forum, 1997a). Laboratory animal experimentation has produced a model for the protective effect of the antioxidant nutrients (Vitamins C and E and betacarotene) in the development of coronary heart disease and many cancers, whereby these antioxidants act as free-radical scavengers; mopping up excess free-radicals in the body. Epidemiological studies have reinforced this hypothesis by demonstrating a possible protective effect of dietary intakes of the Vitamins A, C and E. However, the National Heart Forum (1997a) recently suggested that there is no evidence for the protective effect of *specific* antioxidants. There is also evidence of a cause-effect relationship between dietary supplementation of betacarotene and retinol (Vitamin A) with vitamin tablets and increased prevalence of coronary heart disease and lung cancer among high-risk groups (National Heart Forum, 1997a).

2.1.4 The Role of Fruit and Vegetables in the Prevention of Disease

Dietary intake evidence (as summarised by National Heart Forum, 1997a, Chapter 2) does show a correlation between a diet rich in fruit and vegetables and a lowered incidence of coronary mortality and the development of cancer, and cerebrovascular disease (SOHHD, 1993, Tunstall-Pedoe *et al.*, 1989; Crombie *et al.*, 1990). Indeed, it is believed that a diet rich in fruit and vegetables could reduce the risk of developing many cancers by between 25-50% (SOHHD, 1993; p33). Certainly it is unlikely that a nutritionally balanced diet that is rich in fruit and vegetables is at all harmful. The uncertainty is whether it is the presence of the antioxidants in fruit and vegetables that acts as the protective agent, or whether these vitamins and carotenoids are simply markers for other unmeasured beneficial nutrients. It has also been noted that the study participants who consume diets rich in fruit and vegetables are usually also less likely to be overweight, less likely to smoke, consume lower levels of saturated fat, and are of social class I or II. All of these factors will also diminish the risk of developing coronary heart disease or cancers, so the direct role of fruit and vegetables in prevention of these chronic diseases is not clear-cut (National Heart Forum, 1997a).

However, dietary intakes of antioxidants do vary considerably depending upon socio-

economic status, age and geographic region. The average ratio of vitamin E (alpha-tocopherol) concentration to serum cholesterol level is indicated in Table 2.1 below (taken from Gregory *et al.*, 1990). A lower ratio is indicative of increased coronary heart disease risk.

Table 2.1: The influence of geographic and demographic factors on the ratio of vitamin E concentration to serum cholesterol levels

Region	London/ S. East	Central/West	North	Scotland	
	4.72 ± 0.06	4.70 ± 0.06	4.52 ± 0.08	4.56 ± 0.13	<i>p</i> <0.05
Social class	I and II	III	IV and V		<i>p</i> <0.01
	4.83 ± 0.07	4.35 ± 0.06	4.41 ± 0.08		
Work status	In work	Unemployed			<i>p</i> <0.01
	4.73 ± 0.04	4.08 ± 0.10			
Smoking status	Non-smokers	1-20 cigarettes/day	>20 cigarettes/day		<i>p</i> <0.01
	4.82 ± 0.05	4.41 ± 0.09	4.22 ± 0.08		

(Source: Gregory *et al.*, 1990)

Table 2.1 shows that those living in Scotland or the north of England have lower vitamin E: serum cholesterol ratios. This may place them at greater risk of coronary heart disease than those in the other areas. Social classes III, IV and V and the unemployed are also at increased coronary heart disease risk, as are smokers.

The Scottish Heart Health Study (Bolton-Smith *et al.*, 1991) found a relationship between coronary mortality in men and fruit and vegetables consumption. Of the group with the highest coronary mortality, 30% ate no fruit, and 17% ate no green vegetables. In contrast, of the group with the lowest coronary mortality, just 13% ate no fruit and 6% ate no green vegetables.

2.2 The Consumption of Vegetables in the UK

2.2.1 Current Fruit and Vegetable Consumption in the UK

The 1986/87 *Dietary and Nutritional Survey of British Adults* (Gregory *et al.*, 1990) put average consumption of fruit and vegetables at 250g per day. The 1995 National Food Surveys (Ministry of Agriculture, Fisheries and Food, 1996) showed an average intake of 184g/day (calculated from the total vegetable intake, excluding potatoes, as shown in Table 2.2) which shows a decline in intake, despite the publication of government-backed targets. The consumption data for 1996 (Ministry of Agriculture, Fisheries and Food, 1997; Table 2.10 in the MAFF report) shows that vegetable consumption in Great Britain has marginally increased from the previous year to 191g/day per person. However, this is still well below the recommended 400g/day. Table 2.2 also shows that among earning households, vegetable consumption (excluding potatoes) has a linear relationship to income. The exception to this rule of thumb is income group D, who consume less fresh vegetables than the other earning households but greater quantities of processed vegetables.

To match the targets set by the COMA report (Department of Health, 1994), WHO (1990) and the Scottish Office (SOHHD, 1993) would require approximately a 60% increase in fruit and vegetables consumption. Those in the higher socio-economic groups would require a 30% increase, whereas to reach the targets would necessitate a 100% increase over current consumption for those in groups IV and V (National Heart Forum, 1997a); equivalent to social class D (i.e. semi-skilled and unskilled workers).

Table 2.2: Consumption for vegetables by income group, 1995^(a) and 1996

INCOME GROUP ^(b)						
Households with one or more earners					Households without an earner	
<i>Grams/person /week</i>	A	B	C	D	E1	E2
All vegetables	1999 (1754)	1948 (1967)	2075 (2033)	2171 (2262)	2630 (2554)	2198 (2115)
Of which:						
Fresh potatoes	625 (532)	664 (729)	818 (792)	871 (1026)	1093 (973)	920 (918)
Fresh green vegetables	253 (224)	211 (205)	211 (198)	193 (210)	340 (364)	197 (217)
Other fresh vegetables	588 (556)	487 (485)	432 (421)	429 (398)	690 (705)	412 (410)
Processed vegetables	533 (442)	586 (548)	614 (622)	678 (632)	507 (512)	669 (570)
Vegetables (excluding potatoes)	1374 (1222)	1284 (1238)	1257 (1241)	1300 (1236)	1537 (1581)	1278 (1197)

(Source: Adapted from Table 2.2.19 NFS, MAFF 1997; Table 5.8 NFS, MAFF 1996)

(a) *Figures in brackets are average consumption figures for 1995.*

(b) *1997 Definition: Gross weekly income of head of households A £595 and over, B between £310 - £594, C between £150 - £309, D under £150, E1 £150 and over, E2 under £150.*

2.2.2 Fruit and Vegetable Consumption among Children and Adolescents

A 1994 study of London inner-city children from disadvantaged social backgrounds found that 37% of these 12-13 year olds ate no fruit at all during the week of the study. A further cause for concern was that 81% of the children did not consume vegetables on a daily basis (Doyle *et al.*, 1994). The previous year, a study of 126 children aged between 10-15 years found that 25% of the participants had not eaten any fruit and vegetables on that particular day (Williams and Ward, 1993). Furthermore, 56% of the children had eaten only one portion of fruit and vegetables, and just 8% had eaten five portions in line with the dietary recommendations.

In Scotland, a study of almost 2, 000 Tayside children aged between 10-11 years revealed that less than 25% ate more than three portions of fruit and vegetables per day (Wrieden, 1996). Anderson *et al.* (1994a) discovered that over one-third of the respondents in their West Coast survey ate vegetables less than once a week, if indeed at all. The authors suggested that the increase in snack food consumption in place of “proper meals” (including vegetables) was one reason for the very low consumption rates.

In the light of the epidemiological evidence discussed earlier, such low fruit and vegetables consumption rates among British children are indeed a worrying trend. It is possible that a change in social habits (more mothers working, increased snacking in place of ‘three square meals’) in Britain has been partially responsible for the low fruit and vegetables consumption of children. Retail data also reveals a general decline in fresh vegetable consumption in Britain.

2.2.3 UK Fresh Vegetable Market

Between 1991-1995, consumption of fresh vegetables decreased by 6.5% to 4.3 million tons, whilst consumption of fresh fruit increased by 9.4 % to 1.9 million tons (Retail Business, 1997). This suggests that encouraging the British population to eat sufficient fruit is not likely to be so much of a problem as compared to vegetables. Britons consume far less fruit and vegetables than inhabitants of other western European countries, despite promotions from trade bodies and the health profession (Retail Business Part 2, 1997). Whilst the overall consumption figures in the UK have fallen, the consumption of some vegetables has seen an increase.

Consumption levels for most categories of fresh fruit and vegetables have increased since the 1970’s, with the exception of potatoes, and fresh green vegetables. The latter have witnessed a 31% decrease in consumption in the 20 years from 1975-1995, whilst consumption of other fresh vegetables has increased by 17% (1995 National Food

Survey, p.71, MAFF 1996). Within the vegetable sector, sales of speciality vegetables (including aubergines, and green and red peppers) and mushrooms have shown substantial growth, while the growth in tomato and salad vegetables showed a more conservative increase (Retail Business, 1997).

Within the declining fresh green vegetable sector, the most consumed vegetable in 1995 was cauliflower representing 33% of the total consumption, an 11% increase between 1975-95 (1995 National Food Survey, p.71, MAFF 1996). This might seem surprising until it is realised that 'Cauliflower' as a category includes headed broccoli (calabrese), which could be responsible for the popularity of cauliflower as a group. Cabbages and Brussels sprouts are becoming less popular with consumers, although cabbages still represent 26% of consumption in the fresh green vegetable section (See Table 2.3). Carrots are the most frequently consumed 'other fresh vegetable' (23% of the total consumed), and are the most popular of all the fresh vegetables consumed in the UK (1995 National Food Survey, p.71, MAFF 1996; Retail Business, 1997).

It has been suggested that an increase in the number of women in paid employment, and increased foreign travel have lead to a demand for both convenient, and exotic/ethnic foods, causing a decline in the consumption of 'traditional' fresh vegetables (Retail Business, 1997). This is illustrated by the rise in the consumption of vegetables in the 'miscellaneous fresh vegetables' sector of the 1995 National Food Survey's Table 5.1 (p70, MAFF 1996). The trade and retailers have responded to these consumer demands by producing a range of prepared vegetables and salads, including packs containing all the vegetables needed for stir-fries, often including an ethnic sauce.

The move towards convenience foods that 'save time' also seems evident from the National Food Survey data presented in Table 2.3. The average 'at home' consumption of processed vegetables has increased over the past 20 years, whilst that of fresh green vegetables has shown a steady decline. Conversely, the consumption of other fresh vegetables has also been increasing, although quite slowly, probably due to the

mentioned availability of a wider range of newer varieties.

Table 2.3: In-Home Consumption of Vegetables, 1975-96.

(g/person/week)

	1975	1980	1985	1990	1995	1996
Fresh green vegetables	327	353	276	277	225	233
Other fresh vegetables	390	449	445	459	470	489
Processed vegetables^a	417	458	525	529	563	591
Total	1134	1260	1246	1265	1258	1313

a Includes canned, bottles, dried, frozen vegetables, crisps and other potato products, vegetable juices.

Source: 1995 & 1996 National Food Survey (MAFF 1996 & 1997).

2.2.4 The Influence of Demographic Factors on Household Fresh Vegetable Consumption

One factor which the National Food Survey (NFS) showed decreased the amount of fresh green vegetables consumed in a household was an increase in the number of children present (MAFF, 1996). Another factor influencing fresh vegetable consumption was the income group of the head of the household (Table 2.2). Households in income groups A (£595+ per week gross) and B (£310-£594) ate more vegetables than did those in the lower earning group (Group C; £150-£309). Interestingly, in 1996, households in Group D (under £150) ate more vegetables than those in Groups B or C. Households typically having the highest weekly consumption of vegetables were those in group E1 who were non-earners with incomes over £150 per week, presumably from state benefits. The NFS defines E1 and E2 households as those without a person working more than 10 hours per week. Of those households fitting this criterion, pensioners (OAPs) and those containing at least one person who has been unemployed for less than one year are excluded from the E1/E2 categories.

Household average vegetable consumption is also dependent on geography. Scotland has the lowest consumption of both green and other vegetables, whilst England has the highest (NFS, MAFF 1997; MAFF 1996). In both 1995 and 1996, Scotland's average vegetable consumption has been lower than that of even the regions in England with the lowest consumption rates (the North, and the Northwest). In 1995, the greatest consumers of fresh vegetables in Britain were to be found in the East Midlands (MAFF, 1996) whilst in 1996 the Southeast/East Anglia was the region with the highest consumption (MAFF, 1997) as seen in Table 2.4.

Table 2.4: Consumption of Fresh Vegetables by Region, 1995 (in brackets) and 1996
(g/person/week)

	Green vegetables	Other vegetables	Total vegetables
England	(234) 242	(482) 498	(716) 740
North	(180) 206	(430) 486	(610) 692
	(228) 222	(470) 456	(698) 678
Yorkshire/Humberside			
North West	(183) 193	(424) 521	(607) 714
East Midlands	(276) 235	(503) 519	(779) 754
West Midlands	(246) 287	(471) 490	(717) 777
South West	(244) 246	(507) 507	(751) 753
South East/East Anglia	(247) 260	(510) 535	(757) 795
Wales	(228) 221	(460) 456	(688) 677
Scotland	(136) 159	(359) 433	(495) 592
All households	(225) 233	(470) 489	(695) 722

Source: National Food Survey (MAFF, 1996; Tables 2.10 and 2.16, MAFF 1997)

2.2.5 Campaigns to Increase Fresh Vegetable Consumption

An increase in the consumption of all types of vegetables is necessary to move in line with the dietary recommendations. Possibly one way to increase the consumption of fresh vegetables would be to advertise both the produce, and the health benefits associated with

consumption. Advertising campaigns for fresh vegetables (and fruits) tend not to focus on a brand name, instead highlighting consumer awareness of a particular vegetable (Retail Business, 1997 Part 2). In 1996, mushrooms were the only fresh vegetables (excluding potatoes) to receive any main media attention (Retail Business, 1997 Part 2). In total, the 1996 advertising spend on fresh vegetables and fruit combined was £11.5 million split between the fresh produce industry and the supermarket campaigns (Retail Business, 1997 Part 2). In contrast, 1993 figures show that £70 million was spent advertising chocolate confectionery, along with £20.1 million on crisp and snack-food advertisements (Leather, 1993; Leather, 1997).

In 1994, health promotion campaigns were launched to raise consumer consciousness of the benefits of consuming fruit and vegetables and to inform consumers of the recommended quantity to be eaten. The Fresh Fruit and Vegetable Information Bureau (FFVIB) launched two consumer awareness campaigns in this year; “Fresh is Beautiful” featuring the model Marie Helvin, and “Five A Day”. The latter was launched as part of Europe Against Cancer’s campaign in October 1994, backed by the Department of Health, the Ministry of Agriculture, the fresh produce industry and the main food retailers (Retail Business, 1997 Part 2). “Five A Day” was given its television network launch on BBC2’s ‘Food and Drink’, and the supermarket chain Asda went on to use the “Five A Day” logo on some in-store promotional material, whilst other supermarkets promoted the concept of five portions of fresh fruit and vegetables per day (Retail Business, 1997 Part 2).

During 1996/97, the FFVIB “Five A Day” logo was updated to “Go for 5 a day” which appeared on some promotional, and point-of-sale material in the multiple retailers (Retail Business, 1997 Part 2). Also in 1996, the Fresh Produce Consortium spent £500,000 on the “Get Fresh” campaign (Bowman and Stewart, 1997). The “Get Fresh” campaign was the result of qualitative research which evaluated consumers’ attitudes towards fresh fruit and vegetables, and attempted to motivate those with low fruit and vegetable intakes by targeting messages specifically to them. However, decreasing fresh vegetable

consumption rates (MAFF, 1998) suggest that either British consumers are not aware of these campaigns, or the campaigns were unsuccessful at motivating consumers to change their consumption habits.

Whilst the efforts of the industry and trade bodies to promote increased consumption of fresh fruit and vegetables are important, consumers need to be encouraged to consume more vegetables in any format (i.e. fresh or processed). Frozen vegetables, especially quick-frozen varieties, are equally beneficial from a nutritional perspective (Haard, 1995; p.275) and can be a convenient option for many consumers. Cathro *et al.* (1995) interviewed both high and low vegetable consumers and found that low vegetable consumers tended to find frozen vegetables more convenient, whilst the high vegetable consumers preferred the taste of fresh vegetables (p. 28 of the Cathro *et al.* report).

2.2.6 UK Frozen Vegetable Market

In Britain the majority of all vegetables consumed are fresh rather than processed, although the frozen market remains an important sector (Retail Business, 1997). The 1995 National Food Survey (MAFF, 1996) showed that frozen green vegetables represent 10% of all green vegetables consumed. Within this sector, frozen peas are dominant (82% of volume and 78% of value) (EIU Retail Business, 1995). In 1994, the UK frozen vegetable market was valued at £652m in total (EIU Retail Business, 1995). However, in the period 1990-1994, the UK market for frozen green vegetables decreased by 1%. This could be attributed to the all-year availability of 'seasonal' fresh vegetables, the introduction of exotic varieties, and to changes in eating habits, with a reduction in people eating a "meat and two veg" meal (EIU Retail Business, 1995).

2.2.7 The Influence of Demographic Factors on Household Frozen Vegetable Consumption

In spite of observed decreases in the market for frozen green vegetables (EIU Retail Business, 1995), household weekly consumption of all varieties of frozen vegetables was

seen to increase by 13% between 1990 and 1994 (MAFF, 1995). The disparity between sales of frozen vegetables and the consumption figures could be due to over-reporting on the part of the National Food Survey participants.

As is the case with fresh vegetable consumption, differences in household consumption of frozen vegetables have been found to be related to income groups, with the highest income group (£520 + per week) eating 15% below the national average, and the lowest earners (Group D; under £140 per week) eating 12% above the national average (MAFF, 1995). The figures for consumption of frozen vegetables during 1996 (Table B5; MAFF, 1997) show that Group D again consumed the most frozen vegetables of the earning households (21% above the average for all households), equalled by Group E2 (non-earners on under £150 per week). Once more, in 1996 Group A households (£595+ per week) ate the least frozen vegetables (15% below the average weekly consumption rate) (Table B5; MAFF, 1997).

National differences were also apparent, with both England and Wales showing slightly above average consumption, while Scotland's consumption was 12% below the average in 1995. This pattern was repeated in 1996, with frozen vegetable consumption in Wales being above the GB average, and Scotland having below average consumption rates (Table D2; MAFF, 1997). The presence of children in the household also generally resulted in a decline for household frozen vegetable consumption in both years (Table B7, MAFF 1997; MAFF, 1996).

2.3 The Scottish Vegetable Market

Scotland's population has the lowest vegetable consumption of all British 'regions', and also one of the worst diet-related health records in the Western world. As the National Food Survey (MAFF) groups together all Scottish households as one British region, it is

not possible to use the data to build a detailed picture of vegetable consumption in the different regions of Scotland. The Institute of Grocery Distribution (IGD) did however publish a detailed review of the Scottish food market (IGD, 1995) which illustrated the differences in consumption patterns within the main Scottish cities. Scotland contains 8.5% of the total UK households, with 60% of the Scottish population residing in either Strathclyde or Lothian conurbations (IGD, 1995).

The Scottish food market is noticeably different to that of the UK as an average (IGD, 1995). For example, 7% of Scottish consumers shop for groceries on a daily basis compared to 3.7% of overall UK consumers. The IGD believed that this was partly due to low car ownership in Scotland over-riding the 'one-stop' shopping concept, a high proportion of the population residing in flats which may have limited food storage space (and stairs to climb), fewer superstores in rural areas, and the high number of convenience stores in the major Central belt conurbations. Some of these factors may influence the lower consumption of vegetables in Scotland as compared to England.

An additional barrier to adequate vegetable consumption in Scotland is the absence of the fresh vegetable retail markets enjoyed by consumers in other parts of Britain. These retail markets typically offer produce at lower prices than the supermarkets/grocery shops, and while the quality may not be Grade A as sold in the supermarkets, it is still of a good standard.

The IGD report (1995) also showed differences in the vegetables most commonly consumed in Scotland compared to the UK average (Table 2.5). Soups have also been included, as they can be a valuable source of vegetables for many Scottish consumers. Taking the average UK consumption = 100, Scottish consumption figures for the following vegetables (and soups) are shown:

Table 2.5: Scottish Consumption of Vegetables Compared to the UK Average

(UK average=100).

Tinned soup	160
Packet soup	123
Tinned sweetcorn	114
Fresh sweetcorn	102
Baked beans	94
Root vegetables	94
Potatoes	92
Tinned Peas and beans	90
Prepared salads	87
Other vegetables and herbs	87
Frozen vegetables	85
Peas	85
Total vegetables	84
Mushrooms	83
Tomatoes	80
Salad vegetables	72
Greens	64
Green beans	42

Source: IGD(1995): Scotland in Perspective: an overview of the Scottish grocery market.

It is apparent how important soup is to the Scottish population, sometimes attributed to the climate, which is colder than that in the south of England (e.g. Cathro *et al.*, 1995, p.42). The Scottish climate has been suggested as a barrier to fresh vegetable (and fruit) consumption, as people would rather eat something “comforting” than a piece of fruit, or a salad (Anderson *et al.*, 1994a) and certain varieties of vegetables are perceived as more appropriate to particular seasons (Anderson *et al.*, 1994c).

The leisure profile of the Scottish population also reveals that a higher proportion of Scots (22.5%) than UK consumers as a whole (14.8%) lack access to either a garden or an allotment (IGD, 1995). This will hinder the Scottish consumers’ ability to grow their own vegetables and might influence their high consumption of tinned vegetables (a score of 164 for tinned vegetables based on a UK average of 100).

2.3.1 Regional Variations Within Scotland

By studying the purchasing profile for each region of Scotland compared to the Scottish average (Table 2.6), it can be seen that the Borders are below the national average for both tinned and fresh vegetables (IGD, 1995).

Table 2.6: Regional Vegetable Purchasing Profiles Compared to the Scottish Average

(Scottish average = 100). n/a = data not available

	Fresh vegetables	Tinned vegetables	Frozen vegetables
Borders	78	68	n/a
Central	n/a	107	106
Dumfries and Galloway	n/a	n/a	n/a
Fife	n/a	n/a	n/a
Grampian	129	n/a	n/a
Highlands and Islands	n/a	n/a	n/a
Lothian	113	n/a	103
Strathclyde	n/a	114	101
Tayside	111	n/a	n/a

Data on the vegetable purchasing habits of those residing in the Highlands and Islands, Fife and Dumfries and Galloway is not available from the IGD report. It is worth considering the population of Scotland residing in rural areas (e.g. the Western Isles), for whom purchasing ‘healthy’ food items may be prohibited by the high cost, or poor availability of quality goods (Clark *et al.*, 1996). A comparative study of the cost of a ‘healthy’ diet in rural and urban areas, conducted in 1990 by the Welsh Consumer Council found healthier options to be less readily available in rural areas and foods in general to be more expensive (cited in Leather, 1992).

2.3.2 Profile of Consumers in the Major Cities in Scotland: Vegetable Consumption

The four major cities in Scotland are Glasgow (13.3% of the Scottish populace), Edinburgh (8.4%), Aberdeen (4.1%) and Dundee (3.3%) (IGD, 1995). There are

interesting differences between consumers from the different cities, most noticeably between those from Glasgow and those from Edinburgh.

In terms of the size of their populations, the two major Scottish cities are Edinburgh and Glasgow. There are interesting differences between these two cities in terms of the citizens' average vegetable intakes, with Edinburgh residents on average consuming greater quantities than those residing in Glasgow (Tunstall-Pedoe *et al.*, 1989). However, the Glasgow City boundary includes both the area with one of the highest vegetable consumption levels in Scotland (Eastwood), and also that with the lowest (North Glasgow). The Clydeside conurbation of North Glasgow is an interesting area in terms of coronary mortality rates, which have been linked to (among other risk factors) a low consumption of fruit and vegetables (Tunstall-Pedoe *et al.*, 1989). The population of Clydeside typically has a high coronary mortality rate, with the exception of two districts which have very low mortality rates; Bearsden and Milngavie, and Eastwood (Crombie *et al.*, 1986). To attempt to explain these differences in coronary mortality rates, it is worth studying the profiles of the citizens of these cities, and their typical vegetable consumption.

2.3.2.1 Edinburgh City (8.4% Scottish population)

Edinburgh contains significantly higher numbers of affluent metropolitan households (24.1% in Edinburgh versus 6.6% in Scotland overall), therefore, not too surprisingly there is also a significantly lower proportion of Local Authority accommodation (19.9% in Edinburgh, compared to 37.9% overall in Scotland) (IGD, 1995). The capital city also has a significantly higher proportion of households earning above £20, 000 (31.3% *versus* 24.3% in Scotland overall) (IGD, 1995), so the average citizen can be deemed to be comfortably affluent. Fresh vegetable consumption is above the national average for Scotland with a value of 120 (where the Scottish average = 100) (IGD, 1995), although unfortunately it is not known which particular vegetables are consumed the most. IGD (1995) suggests that the average Edinburgh consumer is "*particularly discerning and eats a healthy, balanced diet. Fresh produce feature highly in the profile...*" This goes some

way towards explaining the significantly lower coronary mortality rates in the capital as compared to Glasgow (Tunstall-Pedoe *et al.*, 1989).

2.3.2.2 Glasgow (13.3% Scottish population)

Glasgow is the west-coast 'rival' city to Edinburgh, housing a greater percentage of the national population than does the capital city. In contrast to Edinburgh, Glasgow has a higher proportion of Local Authority owned homes (48.5%) as compared to the national Scottish average of 37.9% (IGD, 1995). There are also a higher proportion of semi-skilled and unskilled workers residing in the city than for the rest of Scotland (IGD, 1995). Glasgow also has a higher proportion of the following groups:

High unemployment Council estates (22.0% in Glasgow; 6.8% Scotland)

Greatest hardship Council estates (19.2%; 7.4% for Scotland)

Affluent urbanites in town and city areas (4.7% Glasgow; 2.9% Scotland)

Prosperous professionals in metropolitan areas (3.0% Glasgow; 1.3% Scotland)

Better off executives in inner city areas (7.2% Glasgow; 3.7% Scotland)

A significantly higher proportion (34.0%) of Glasgow's households earn less than £10,000 as compared to the national Scottish average of 28.1%. All other income brackets are below the national average (IGD, 1995). So it can be seen that the Glasgow populace are extremely diverse with regard to their social background.

Low car ownership in Glasgow means that most of the city's consumers travel by bus, or on foot to do their grocery shopping (IGD, 1995). As has been mentioned earlier with regards to the Scottish population as a whole, reliance upon public transport might be a barrier to vegetable consumption. However, the IGD report makes no mention of the use of the Underground or low-level trains to access supermarkets near to the stations.

Possibly due to the high levels of low-income households that make up the city's population, the Glasgow diet is based mostly on food staples and packaged foods are a

main part of the weekly diet. Glaswegians consume above average (Scottish) amounts of both packet soups (score of 110) and tinned vegetables (a score of 118) (IGD, 1995).

2.3.3 Comparing Glasgow Consumers to Edinburgh Consumers

Taking the average Glasgow consumption to be 100, Edinburgh consumption of peas and other vegetables (not potatoes) is higher (113) (IGD, 1995). Fresh vegetables are more popular in Edinburgh (185) than in Glasgow, and also tinned soup (129). Glasgow has a higher consumption of tinned vegetables and frozen foods than Edinburgh does, suggesting that less emphasis is placed on cooking fresh vegetables. Nonetheless, consuming frozen or tinned vegetables can often be as beneficial to one's health as eating them fresh, especially if the 'fresh' varieties have been stored for a long time before consumption, thus reducing their nutrient content.

So in summary, it can be seen that there are differences in consumption levels for vegetables (fresh and frozen) between Scottish consumers and those in the rest of Britain (in particular, England), with significantly lower vegetable intakes among the Scottish population. Within Scotland, the 1995 IGD report showed that the typical consumption of vegetables (amount, and type) varies between the two largest cities (Edinburgh and Glasgow), which can partly be attributed to the demographic characteristics of the populations of the two cities. The National Food Survey data (MAFF, 1996 and 1997) also shows that socio-economic background influences vegetable consumption, with lower income groups typically consuming less than those who are more affluent. The type of vegetables consumed also seems to be influenced by socio-economic status, whereby those on lower incomes (and non-earning households) consume greater quantities of processed vegetables (tinned and frozen) than do those of higher socio-economic status. And finally, the presence of children in a household characteristically results in a reduction in the amount of vegetables consumed per person (MAFF, 1996 and 1997).

A number of research projects have found that children have a very influential role in

determining household vegetable consumption. Recently, a study of low vegetable consumers in Scotland and England (Cathro *et al.*, 1995) discovered that the preferences of the subjects' partners and children were important influences when deciding which vegetables, if indeed any at all, were to be served at mealtimes. Marshall and colleagues (1994) and Piacentini (1998, pp.88-91) have also found children to exert considerable control over family vegetable consumption.

2.4 Scottish Children's Consumption of Vegetables

With knowledge of the benefits to health, the importance of encouraging children to consume sufficient fruit and vegetables cannot be over-emphasised. Unfortunately, Scottish children appear to be following the example set by their parents, consuming particularly low quantities of vegetables compared to their contemporaries in the rest of the UK (Department of Health, 1989). The previously mentioned studies conducted by Wrieden (1996) and Anderson *et al.* (1994) reinforce this trend. The disparity in Scotland between vegetable consumption and that of fruit, as mentioned earlier, can be illustrated by a study of East Coast secondary-school children conducted by Wrieden and Moore (1995). They discovered that only 35% of the sample ate vegetables every day, whereas 53% ate fruit on a daily basis. All in all, the current scenario regarding Scottish children's vegetable consumption appears gloomy. It would therefore seem sensible to address the issues underlying the establishment of their collective low consumption of vegetables, by examining the factors that affect food acceptance and preferences in children.

2.5 The Factors Affecting Food Acceptance and Preferences in Children

2.5.1 Food Choice Models

There are a number of published models that illustrate the abundance of factors that affect an individual's food choice, as summarised by Shepherd and Sparks (1994). Shepherd (1985) has himself proposed a food choice model (Figure 2.1) that shows the factors that have the most influence on human food choice/intake. Such models are not without their

flaws.

The concept of food 'choice' under some circumstances may be debatable. The model shown in Figure 2.1 does not really apply to an infants' food intake, whereby they have no choice over what they are fed and their hunger cues may not always be interpreted as such by the parent. Certainly with regard to their child's food intake, the parents are influenced by the factors illustrated in such models. For example, certain economic, social and psychological factors are likely to influence a mother's decision to either breast-feed or formula feed her baby, the age at which she moves her child onto solid foods and the foods that the parents choose to give to their child.

According to Steiner (1977), a newborn baby will indicate displeasure if given bitter and sour-flavoured liquids and will show a preference for sweet tastes. These inherent flavour preferences seem to continue until we learn to overcome our aversion to bitter tastants in particular (Ton Nu *et al.*, 1996). Even a very young child may control their own food intake by refusing to eat a disliked food (chosen by their parents), or by making a choice from a selection offered by a their parent once they are old enough. However, to a large degree a young child's food choice is under the control of their parents, so models such as that shown in Figure 2.1 are not wholly applicable to their situation. In other circumstances, children can act as gatekeepers with regard to their parents' intake of particular foods, e.g. vegetables (Piacentini, 1998 pp.88-91; Cathro *et al.*, 1995; Marshall *et al.*, 1994).

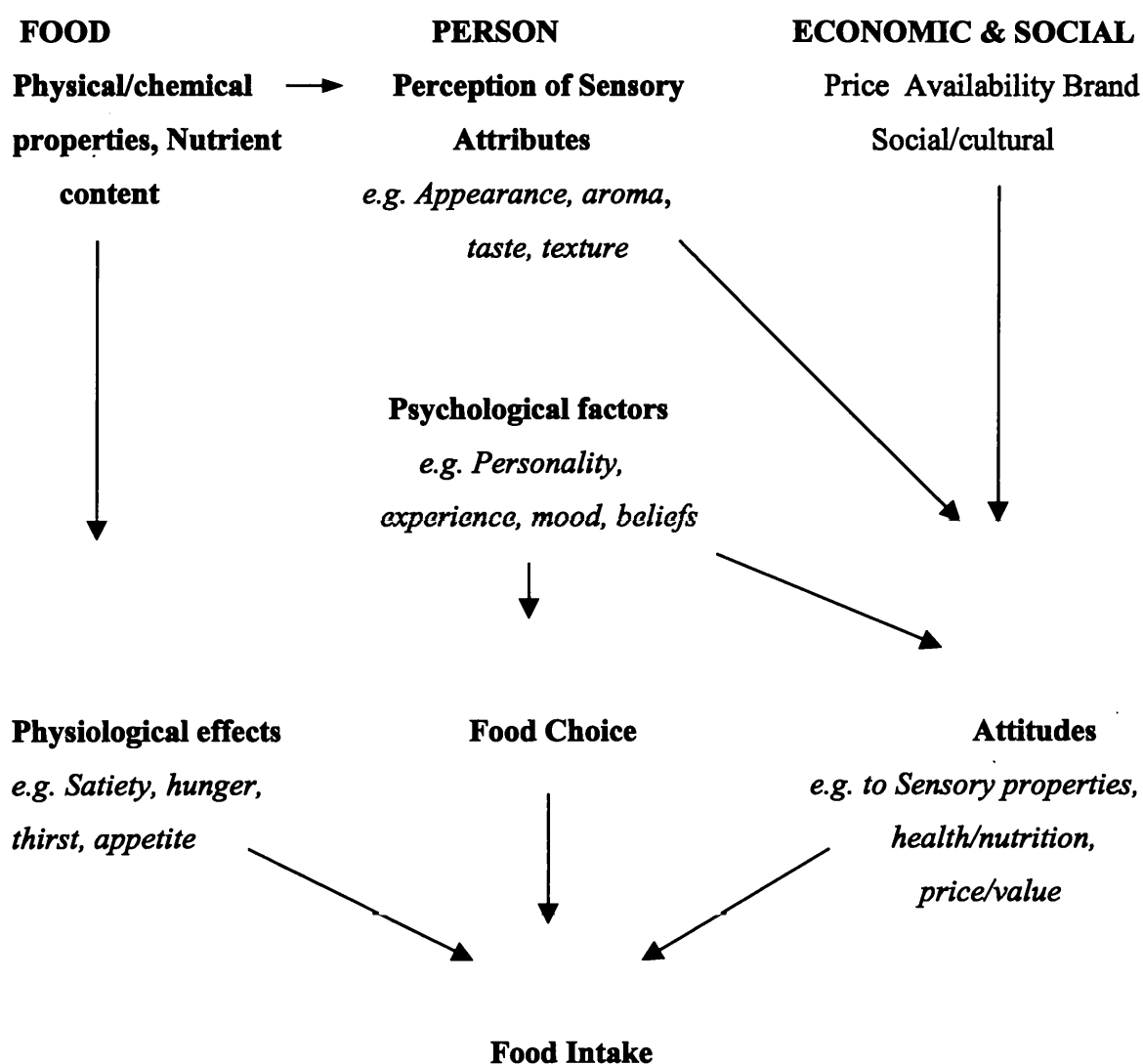


Figure 2.1: Some Factors Affecting Food Choice and Intake (taken from Shepherd, 1985).

A person's beliefs and attitudes, along with their food preferences (which help to form attitudes towards foods), are thought to be reliable predictors of their food choice (Shepherd and Sparks, 1994). As such, much research has centred on the modelling of

food choice by measuring individuals' attitudes (using a questionnaire), and applying models such as the theory of reasoned action (Fishbein and Ajzen, 1975; Ajzen and Fishbein, 1980) and the theory of planned behaviour (Ajzen, 1991).

The theory of reasoned action works on the assumption that in situations where an individual's behaviour is under their control (e.g. increasing their consumption of fruit and vegetables), their intention to perform that behaviour is the best predictor of actual behaviour. Behavioural intent (the conscious decision to perform the behaviour) is in turn dependent upon the combined impact of the individual's attitudes towards the behaviour (e.g. the individual thinks that eating more fruit and vegetables would be good for their health, and it would help them to lose weight), the perceived social pressure (the 'normative beliefs') to behave in this way (e.g. their doctor has suggested that they increase their fruit and vegetables intake, their family expect them to eat more fruit and vegetables) and the individual's motivation to comply with this social pressure.

There have been criticisms of the measurement of attitudes to predict consumer's behaviour, some of which are explained by East (1997). It is imperative that the questions used to measure attitudes are phrased correctly. For example, using the scenario in the preceding paragraph, the individual may believe that consuming fruit and vegetables will benefit their health and help them to lose weight, indicative of a positive attitude towards increased fruit and vegetable consumption. However, contrary to expectations, they may not actually increase their intake because the shops in their local area do not sell good quality produce, they perceive fruit and vegetables as being too expensive and find them too heavy to carry up the stairs in their tenement block.

Figure 2.2 shows a schematic version of the theory of reasoned action. Further detail on the theory of reasoned action and its application in food choice research can be found in Shepherd and Sparks (1994) and Shepherd (1990).

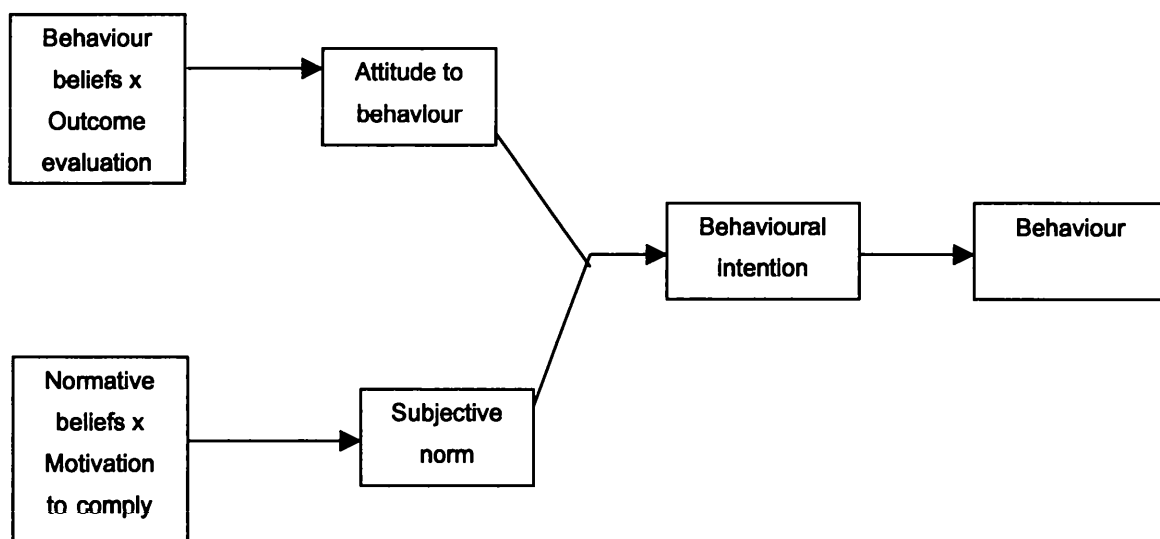


Figure 2.2: Model of the Fishbein and Ajzen Theory of Reasoned Action.

The theory of planned behaviour (Ajzen, 1991) is similar to the theory of reasoned action, but takes into account an additional measure, viz. the perceived control that an individual has over a behaviour. For example, the individual who wishes to increase their fruit and vegetable intake but was hindered by the fact that their local shops do not stock good quality produce would have this accounted for as a measure of perceived control using the planned behaviour model.

Based on models such as the theory of reasoned action, consumers' attitudes, beliefs and barriers to increased fruit and vegetables consumption are of much importance.

Worldwide, studies have been undertaken to elicit these psychosocial determinants of food choice and to evaluate their impact on consumers' consumption of fruit and vegetables (e.g. Brug *et al.*, 1995; Cox *et al.*, 1998; Piacentini, 1998; Balch *et al.*, 1997; Neale *et al.*, 1995). Many researchers have made attempts to change consumers' attitudes to fruit and vegetables in an attempt to increase consumption (Dittus *et al.*, 1995; Stafford, 1995; Laforge *et al.*, 1994; Cox *et al.*, 1996). Models such as the Health Belief Model hypothesise that an individual will be ready to increase their fruit and vegetables

intake if they are made aware of the health benefits and consider themselves to be at risk of coronary heart disease and cancer. Dittus and colleagues (1995), using this model with adults, found that attitudes towards fruit and vegetables were of less importance than the perceived barriers to individuals' fruit and vegetable consumption. It is unlikely that young children will strongly believe themselves to be at risk of developing coronary heart disease and cancers because of their diet. Therefore the chances of successfully increasing their fruit and vegetables consumption by applying the Health Belief Model seem slim.

Shepherd and Sparks (1994) believe that the theory of reasoned action is generally a good predictor of behaviour and can be used to evaluate the relative importance of different factors upon food choice. However, they also suggest that the influence of an individual's perceived control on ultimate behaviour needs further exploration (as covered in the theory of planned behaviour), as does the role of self-identity (e.g. perhaps a person who believes that they are healthy therefore eats accordingly). Finally, Shepherd and Sparks (1994) suggest that the impact of moral obligation on food choice behaviour should also be researched, especially when the individual is making the choice for others (e.g. for children).

This section has demonstrated that the use of attitudinal models to predict food choice behaviour is a complex area, one that is still being researched to improve the reliability of such models. The food choice model in Figure 2.1 illustrated that attitudes were just one of the influences that affect an individual's food choice. Some of the other factors will now be examined in further detail in relation to children's food acceptance and preferences.

2.5.2 Sensory Factors

2.5.2.1 Innate Responses to Sensory Stimuli

The development of specific food preferences and food aversions begins as an infant is exposed to a variety of different foods during weaning. Sensory properties are obviously

important in determining whether or not a child will accept particular foods. However, in terms of the basic tastes, it has been shown that some preferences are innate. Human taste preferences are evident in neonates, whose facial expressions are indicative of a preference for sweet tastes (Desor *et al.*, 1973; Steiner, 1977), and a dislike of bitter and sour (Steiner, 1977). By the age of four to six months, infants display a preference for salted food over a non-salted version (Cowart and Beauchamp, 1986), demonstrating the formation of definite preferences for the primary tastes at an early developmental stage.

One explanation for the inborn sensory likes and dislikes could be that humans are attracted to safe, energy rich nutrients, which have a sweet taste and reject harmful (bitter) ones. For example, natural toxins (such as plant alkaloids) have a tendency to be bitter tasting, whilst breast-milk is sweet (Rogers and Mela, 1992).

2.5.2.2 Texture

Texture may be an important sensory property that could influence children's decisions to accept or reject vegetables. Muñoz and Civille (1987) believed that the textural awareness of consumers had been raised since earlier work on consumer perceptions of texture was conducted (e.g. Szczesniak and Kleyn, 1963). Szczesniak (1972) had found that teenagers were very conscious of food texture, possibly more so than adults at that time (Szczesniak and Kahn, 1971), creating a new generation where this sensory attribute had heightened importance in respect of food preferences. Food texture was considered by Szczesniak (1972) to be important to American (USA) children in determining their food likes and dislikes. The 3-6 years olds that she studied rejected foods with stringy, mushy, and lumpy textures which were difficult to manipulate in the mouth. These textures are commonly associated with cooked vegetables, and as such were cited as reasons for disliking them by the children in Szczesniak's study. It was suggested that fear of choking or gagging during mastication due to difficult to manipulate textures could be the basis for the children's aversion to these foods (Szczesniak, 1972). The teenagers she studied (aged 13-18 years) preferred to eat raw and salad vegetables displaying the desirable textural properties of crispness and crunchiness. Another study of children's

acceptance of vegetables found texture to be influential in determining preferences for raw vegetables, as well as the dislike of many cooked vegetables (Walker *et al.*, 1973).

Recently in the UK, a study involving mothers from Scotland and England echoed Szczesniak's results, with children particularly refusing soft, cooked vegetables, preferring raw or crunchy vegetables (Stead and Goodlad, 1996). Cathro and colleagues' study (1995) also found that "*younger children were fussy about (the) texture of food, preferring things to be smooth and without perceptible lumps*" (p. 47 of their report). Another study of over 1000 Scottish consumers (Anderson *et al.* 1994c) revealed that their lack of preparation skills limited them not only to familiar vegetables, but also to 'traditional' cooking methods such as boiling, and using vegetables in casseroles or in soups. Vegetables prepared in such a manner are likely to display the soft, mushy textural properties which children reputedly dislike, potentially influencing their decision not to eat them. Edinburgh primary school children were found to link the texture of vegetables to feelings of revulsion (Ross, 1995), demonstrating the ability of this sensory property to prompt many Scottish children's aversion to vegetables. Although the studies mentioned all suggest that texture is important in determining children's acceptance/rejection of vegetables, there was no evidence from the literature (conducted in March 1997 using Food Science and Technology Abstracts CD-ROMs (1969 to present), and Social Sciences Citation Index CD-ROMs) to suggest that any studies had specifically researched this area since the 1970's.

2.5.2.3 Flavour

Given that research indicates the neonate's inherent dislike of bitter foods, it is plausible that many of the rejected foods will have a bitter taste. If one considers the foods that are perceived as "adult" foods in the West, many are indeed acquired bitter tastes (e.g. coffee, some alcoholic beverages, chocolate with a high cocoa solids content). Many green vegetables contain flavonoids and related compounds that are intensely bitter, e.g. cucurbitacins of cucurbitaceous fruits (courgettes, cucumber, marrow) and oleuropein of olives (Duckworth, 1966). A recent study of adults in the USA found that the most

disliked vegetables were those that were perceived as bitter (Drewnowski, 1996). This suggests that one reason for children's frequent rejection of green vegetables could be the sensory properties of these foods.

Sensitivity to bitter tastes has been found to be a heritable trait (Kalmus, 1971). The genetically determined ability to perceive the bitter taste of phenylthiocarbamide (PTC) or 6-n-propylthiouracil (PROP) has been associated with an enhanced sensitivity to other sweet and bitter compounds (Bartoshuk, 1980; as reviewed by Drewnowski and Rock, 1995; Drewnowski *et al.*, 1997a & 1997b). Some studies have shown PROP sensitivity in adults to relate to food preferences (Tepper, 1999; Kaminski *et al.*, 2000), with the latter study finding that PROP tasters rated Brussels sprouts as more bitter than non-tasters. However, an earlier study (Jerzsa-Latta *et al.*, 1990) found non-tasters of PTC did not consume cruciferous vegetables more often than PTC tasters (as had been expected), although it should be noted that a small number of subjects participated (18 tasters and 18 non-tasters). Studies of children's PROP status and food likes and aversions have suggested that this inherent sensitivity to bitter tastes does influence taste preferences. Children who were PROP tasters were found to dislike the taste of raw broccoli (and also high fat dairy foods) more than non-tasters (Tepper, 1999). Anliker *et al.* (1991) found that non-tasters liked green vegetables more than PROP sensitive children, although this difference was non significant. Overall it seems that genetic sensitivity to bitter tastes (PTC and PROP) does influence the taste preferences of adults and children, although most of the studies cited have used relatively small numbers of subjects from which to draw their conclusions.

Van Toller (1994) suggested that children have lower thresholds for bitterness than adults and used this theory to explain children's rejection of bitter-tasting green vegetables. The suggestion was that *"the parents, using their own bitterness standards, deny that there is anything wrong with the taste of green vegetables and try to get the child to eat the food"* (Van Toller, 1994). Ton Nu *et al.* (1996) also found that many French adolescents disliked bitter foods until they reached the age of 13-14 years, reporting that at puberty

they now accepted the green vegetables they had previously disliked. This reinforces Van Toller's hypothesis. Also in support of Van Toller's research were media reports regarding the John Innes Centre where scientists were breeding brassica vegetables with a milder flavour, particularly to enhance their appeal to children (Nuki, 1997). In view of the literature, it seems plausible that it is not until children are repeatedly exposed to bitterness in foods that they can appreciate the sensation, and consequently enjoy (or tolerate) green vegetables.

Children's disliking of the flavour of vegetables is often cited as a reason for low vegetable consumption among the whole family. Children were found to be obstacles to increasing vegetable consumption in an intervention study by Cathro *et al.* (1995); findings that were echoed by respondents in studies of barriers to fruit and vegetables consumption conducted by Piacentini (1998, pp.88-91) and Cox *et al.* (1996).

2.5.2.4 Snack-Food Flavoured Vegetables

In 1997, the British media (The Sunday Times, 13th April 1997, p.5; all the following refer to articles published on April 22nd 1997: The Scotsman, p.9; The Herald, p.15; The Guardian, p.7; The Times, p.6) were excited by research conducted by Strathclyde University's Centre for Social Marketing on behalf of the Cancer Research Campaign and the frozen food chain, Iceland Foods (Stead and Goodlad, 1996). This report led to suggestions that manufacturers should provide snack-food flavoured vegetables aimed specifically at UK children, e.g. cheese and onion flavoured cauliflower. Such "Wacky Veg!" then went on sale in Iceland Foods stores, with flavours such as pizza-flavoured sweetcorn, and (to the media's delight) chocolate-flavoured carrots.

It can be argued that anything that encourages children to consume vegetables is beneficial, and by masking the unpleasant flavour of certain vegetables this will be achieved. However, a limited number of published taste tests conducted with groups of children have found that the children preferred the plain versions to these flavoured vegetables (Wrieden and Bürger, 1998; Anonymous, 1997a; Anonymous, 1997b). Sales

were poor, and the Wacky Veg were withdrawn from sale in July 1997 (personal correspondence from Anne Davey at Iceland plc. by e-mail, Anne.Davey@iceland.co.uk). The flavoured vegetables were free from colourings, although Wrieden and Bürger (1998) found the sugar and salt contents to be elevated in the flavoured carrots and peas as compared to plain versions. Despite the effect of the flavourings on the nutritional composition of the vegetables, the consumption of “Wacky Veg!” may have helped make the reaching targets set in the Scottish Diet Report (SOHHD, 1993) achievable, which might be perceived by some to be a benefit. Indeed, anything that increases children’s consumption of vegetables may be seen as desirable.

On the other hand, lack of preparation knowledge has previously been cited as a reason for low consumption of vegetables by Scottish adults (Anderson *et al.*, 1994c; Marshall *et al.*, 1994). There are two issues related to this. Firstly, just flavouring the vegetables does not mean that the parents/children will be any more knowledgeable of cooking methods, and may still have a limited repertoire of varieties with which they are confident. In fact, peculiar flavourings may have further limited the meals with which these ‘Wacky’ vegetables could be served if the flavours did not complement each other. Secondly, overcooking vegetables not only destroys the vitamin content, but also detrimentally affects the texture. This may be as important to children as flavour, and it was shown in some studies (Wrieden and Bürger, 1998; Anonymous, 1997a; Anonymous, 1997b) that well-cooked ‘natural’ vegetables were more popular than flavoured ones. A further point of concern regarding the sale of such vegetables is that children will be further delayed from learning to accept and enjoy the natural taste of vegetables, and the consumption of chocolate-flavoured carrots surely further reinforced children’s innate desire for sweet foods.

2.5.2.5 Colour

Colour has been shown to influence taste thresholds, taste perception, food preference, and expected food pleasantness and acceptability (Clydesdale, 1993). Children are influenced by colour when choosing confectionery, associating certain colours with

particular flavours e.g. a yellow sweet “tastes sour” (Walsh *et al.*, 1990). These colour-flavour expectations also seem applicable when anticipating the flavour of vegetables. Walker *et al.* (1973) found that students expected a pleasanter taste from light to medium green coloured vegetables than from those that were dark green. This suggests that children may use colour to discriminate between vegetables in terms of preferences based on previous experience of colour-flavour relationships, particularly when faced with a novel variety.

2.5.2.6 Odour

The noticeably different odour of cooked as compared to raw vegetables was commented upon by subjects in an earlier study with children and teenagers (Walker *et al.*, 1973). Odour was usually mentioned unfavourably, particularly in the context of cooked vegetables. Cruciferous vegetables (e.g. Brussels sprouts, cabbage, cauliflower, turnip) are rich in volatile sulphurous compounds which particularly contribute to their characteristic odour (and flavour) when cooked (Duckworth, 1966). These odours could suggest unpleasant taste expectations to children, and further contribute to their unwillingness to taste the vegetables.

2.5.3 Non-Sensory Factors

2.5.3.1 The Acquisition of Food Preferences in Childhood

Infants have a sole source of food until weaning begins, which is when a wide range of new flavours and textures are gradually introduced to the child’s diet. Due to the necessity of expanding their diet, children tend to display minimal neophobia during the early weaning process. The child begins to acquire food preferences and aversions (additional to those innate reactions to some of the basic tastes) through a process of learning. A child’s preference for a previously novel food can be increased by frequent exposure, just looking, or especially actually tasting the food. Being offered the food in a positive social context (e.g. observing a respected model consuming the target food, or receiving praise after consumption) or being aware of positive post-consumption effects can also increase a child’s liking for a food, while the association of consumption with

negative post-ingestion effects (e.g. nausea) will decrease the child's liking for the food via associative conditioning mechanisms. The role of these learning mechanisms in the acquisition of children's food preferences will now be explored below in more detail.

2.5.3.2 Food Neophobia and Repeated Exposure Theory

Food neophobia is the rejection of a novel food because the consequences of ingestion are unknown, the "I don't like it, I never tried it" common with young children (Birch and Marlin, 1982). Other mammals have also been shown to demonstrate food neophobia, which in humans is believed to be related to a primitive survival mechanism, probably as a means of our ancestors avoiding potentially poisonous foods (Rozin, 1982). The 'learned safety' model (Kalat and Rozin, 1973) can be extended to show diminished neophobia when frequently exposed to a previously novel stimulus. In other words, as the number of exposures to an initially novel food increases, so a person's preference for a previously disliked food also increases. This principle was found to be applicable to pre-school children who were encouraged to taste a small amount of a novel food, and indicate their preference for it before and after tasting it (Birch and Marlin, 1982; Pliner, 1982). The children's preferences for the originally novel food increased after tasting. The 'mere exposure' theory suggested that by just looking at the food, the child's neophobia was reduced (Pliner, 1982), although to increase taste preference, actual consumption needs to take place (Birch *et al.*, 1987). Sullivan and Birch (1990) suggested that to change a young child's acceptance of a novel food, up to ten exposures were often necessary. The authors later concluded that the 'repeated exposure theory' was also applicable to infants (Sullivan and Birch, 1994). Unfortunately, most parents are likely to give up trying to get their child to taste a previously rejected food long before reaching the tenth exposure. Hence, the parent's interpretation of the 'rejection' situation is that the child dislikes a particular food.

2.5.3.3 Learned Aversions

Humans learn to associate the consequences (metabolic, physiological and psychological) of eating specific foods with either a 'good' or a 'bad' outcome. In particular, a prompt

and long lasting aversion to the specific qualities of a food frequently occur after a negative outcome, especially nausea and stomach upsets (Rogers and Mela, 1992). This is an associative conditioned response, essentially a Pavlovian response.

It is reported that up to 65% of people can name at least one strong food aversion, many of which stem from childhood when trying new foods, and gastro-intestinal illnesses are common (Rogers and Mela, 1992). We are then learning to associate the sensory property of a food (its flavour, odour, texture, and appearance) with its physiological and emotional post-ingestional consequences (e.g. satiety, nausea, pleasure, happiness), and this is thought to play a major role in the development of food preferences (Shepherd, 1995; Birch *et al.*, 1996).

In the case of food-associated unpleasant physical effects (e.g. nausea), our actual perception of the sensation (flavour or other property) remains unaffected, but we learn that this is, for example, a 'nasty taste' and are likely to develop a conditioned aversion to the food. It is suggested by Rogers and Mela (1992) that the rewarding psycho-biological effects of the stimulants in coffee and alcohol lead adults to like the bitter tastes that they disliked as children. Perhaps it is also the case that adolescents learn to like previously disliked vegetables (as found by Ton Nu *et al.*, 1996) because they appreciate the health benefits associated with consumption, thus giving the food a 'good taste'.

2.5.3.4 Food Preferences and Consumption

It might be expected that children would be more likely to consume the foods for which they state a preference. Indeed this relationship has been demonstrated over a range of food products including vegetables (Babicz-Zielinska, 1999) and high-fat foods (Fisher and Birch, 1995). However, other studies have failed to find a relationship between preferences and intake, e.g. for children's consumption of cheese (Mullan *et al.*, 1996) and fruit (Babicz-Zielinska, 1999). An examination of the literature on adult preferences and related consumption, e.g. a study of young women's consumption in relation to their stated preferences (Drewnowski and Hann, 1999) suggests that for most foods, preference

is a good predictor of intake. However, Drewnowski and Hann (1999) found no significant correlations between preference and consumption of foods that were rarely or never eaten, nor for some highly preferred (but fattening) foods such as pizza and pastries. This illustrates that other factors also influence consumption of certain foods, e.g. weight control, perception of self as 'healthy', availability. The latter is likely to be particularly pertinent to the food intake of young children who, while able to influence their parents using 'pester power', are still reliant on their parents to supply (i.e. purchase and prepare) the majority of the food that they consume.

2.5.3.5 Feeding Techniques

The manner in which a parent first introduces a child to solid foods can affect that infant's future food acceptance patterns. As mentioned earlier, children need approximately ten taste exposures to a previously rejected novel food to increase their acceptance (Sullivan and Birch, 1990). However, if a child persistently refuses to consume a particular food, the mealtime can rapidly develop into a battleground, with the parent trying to force the child to try the food, and the child becoming distressed. Negative associations with that particular food due to parental coercion may make the child's initial dislike of the food even stronger (Birch *et al.*, 1995). Some parents may resort to the 'reward' system, whereby they offer the child an incentive to be given after consumption of the target (previously rejected) food. The reward is often a high-sugar or high-fat food, and a typical target food would be a portion of vegetables, e.g. "If you eat your vegetables, you can have a dessert" (Birch *et al.*, 1995). Unfortunately, this type of practice may have an unintended (and undesirable) effect on the formation of the child's food preferences and acceptance habits.

When a child is offered a food in a positive social context (either as a reward, or in conjunction with a favourable social interaction with an influential person, e.g. parent, sibling, peer), the child's preference for that food is increased (Birch *et al.*, 1980). The reverse can also be true; when a child is coerced into eating a target food, their disliking for that food is reinforced, and their liking for the reward is increased (Pelchat and Pliner,

1986; Birch *et al.*, 1984). It has been concluded that rewarding consumption of a food can make a child like the target food even less than they did prior to commencement of the reward system. The effects of the reward system have been explained in terms of the psychology of self-perception (Shepherd and Sparks, 1992). If a child consumes the target food, they think they like it unless they can see an external reason for consuming it. When a child is rewarded (e.g. allowed outside to play) for eating a target food (e.g. vegetables), the child thinks, "I'm only eating these vegetables so that I can go outside and play". With regards to the food used as the reward, the opposite effect occurs, and the child thinks, "I must like this food (reinforcing the reward), because I am eating it without any external force and I am even doing other things (eating a less-liked food) to earn it" (Shepherd and Sparks, 1992).

Allowing a child to choose the foods that they eat minimises or possibly removes the need for coercion. The National Heart Forum (1997b, p.47) cites US study whereby when children were allowed to choose their own fruit and vegetables, they tended to eat more.

2.5.3.6 Social Context: Peer Modelling

Adults consume vastly different diets as a result of diverse cultural backgrounds, yet the first food we all consumed was exclusively milk (Birch *et al.*, 1995). This indicates that cultural and social factors must play an important role in determining the classification system that children later develop to decide what are 'foods' and what are 'non-foods'. Rozin (1984) suggested that culture and ethnicity were the most potent influences on a child's dietary intake.

Eating, by default, is always a social occasion for a young child as they are either breast-fed or bottle-fed when infants, fed by a parent during weaning, and then helped to cut-up food and to feed themselves when they are toddlers. Parents, other adults, siblings, or friends are often also present when a young child is eating, and these people can be influential (if unsuspecting) role models. One study has shown that children will learn to accept a previously disliked vegetable if they are exposed to members of their peer group

who happen to like that particular food (Birch, 1980b). Bandura's *Social Learning Theory* (Bandura, 1973) also suggested that children are greatly influenced by their models, e.g. their parents and peers, and this influence also extends to feeding and food preferences. 'Modelling' or 'observational learning' is where we learn a skill by observing others doing that behaviour. Bandura (1973) suggested that observing someone being positively rewarded (e.g. verbal praise) for carrying out certain behaviour reinforces our desire to also conduct this behaviour. This theory can be extended to the arena of children's food consumption behaviour, whereby observing someone eating a particular food and being 'rewarded' (e.g. praise, or displaying satisfaction/enjoyment) makes the child want to also eat that food. This has been demonstrated in studies by Birch (1980b)

Younger children (down to the age of two years) have been found to be more susceptible than older children to peer influences with respect to their food choices, especially if that peer is a friend or a more 'powerful' child (Bandura, 1973; Birch, 1980b). The behaviour of familiar adults (e.g. parent, other relative, teacher) in relation to food habits is known to influence children's food consumption behaviour (Birch *et al.*, 1980), and fictional heroes are also effective at influencing children's food choice behaviour (Duncker, 1938 as reported in Birch *et al.*, 1996; Horne *et al.*, 1995 & 1998; Lowe *et al.*, 1998), whilst unfamiliar adults exert no significant influence.

Based on the theories of social learning / peer modelling and the effect of rewards on children's behaviour, Fergus Lowe and colleagues (Horne *et al.*, 1995 & 1998; Lowe *et al.*, 1998) devised and implemented an intervention strategy to attempt to increase children's fruit and vegetable intake. The group decided that for their intervention strategy to be successful it needed to focus on what children currently eat and enjoy, and based on this knowledge, to convey positive messages about fruit and vegetables via peer modelling, with the tightly controlled use of rewards for consumption of target fruits and vegetables. The researchers' theory was grounded in their understanding of the psychology of child behaviour with respect to food.

Essentially Lowe's research group suggested that children's learning and verbal reasoning skills allow them to progress from young children who perceive foods as mere named objects (e.g. 'carrot' or 'courgette') with a particular set of sensory characteristics, to viewing them as a class of objects, e.g. 'vegetables', and attaching meaning to this class name (e.g. the class 'vegetables' now takes on properties as a whole; 'vegetables are...' as opposed to 'carrots are...'). Associated with this learning and verbal reasoning is the role of social learning in the acquisition of food preferences in childhood. Peer modelling can have a powerful influence over children's food choice behaviour (e.g. Birch 1980; Birch *et al.*, 1980), whereby hearing a friend express a negative opinion (e.g. "I don't like vegetables") may lead the observer to copy this behaviour, and more importantly according to Lowe *et al.*, for that child to identify themselves, and to be identified by others (e.g. parents) as someone who behaves in this way (e.g. does not like vegetables). The parents' belief that their child does not like vegetables means they behave accordingly and often reinforce their child's behaviour so that the child becomes rooted in the belief that all vegetables are bad, thus refusing to eat them.

However, Lowe's theory on learning and verbal reasoning with reference to children's food choice behaviour is not infallible. Children may refuse to eat some vegetables but will readily accept other varieties, or the same variety prepared differently. For example, a child may not like cooked carrots but will happily eat raw carrots, or they may dislike fresh tomatoes but enjoy processed varieties (e.g. tomato-based pasta sauce, tomato soup), or they may eat sweetcorn and peas but refuse to eat cauliflower. It is quite plausible that this selective consumption is due to the sensory characteristics of the individual varieties, and refutes the suggestion that a child will extend their dislike of one vegetable to trigger a dislike of all class members ('vegetables'). Nonetheless, the Bangor research group have enjoyed apparent success with their intervention studies, suggesting that their theories were well grounded.

The researchers provided opportunities for children (the 'Food Dudes') to on video

observe other children reacting positively towards, and giving a positive message about eating fruits and vegetables. The assumption was that the observers would start to identify themselves as someone who also likes and eats fruits and vegetables. This peer modelling, combined with repeated exposures to fruits and vegetables in a positive social context (i.e. with rewards) as per the work of Birch and Marlin (1982), Pliner (1982) and Birch *et al.* (1987), was believed to be the key to increasing children's fruit and vegetable consumption. The studies included home-based and school-based interventions and overall showed an increase in the participating children's consumption of a wider variety of fruit and vegetable (i.e. not just restricted to the target varieties), which was seen to continue for at least six months post-intervention, albeit with relatively small numbers of subjects.

2.5.3.7 Familial Influences

In the 'Food Dudes' study (Horne *et al.*, 1995 & 1998; Lowe *et al.*, 1998), parents as well as peers were influential in the success of the project, ensuring the sample varieties were available to the child and providing encouraging verbal feedback. In accordance with the theories of social learning, parents would be expected to be influential role models regarding food choice behaviour. Parental attitudes towards/consumption of foods have been shown to have a variable influence on their children's consumption of the food depending on which study you refer to. Some researchers have found minimal communality (Birch, 1980a) whilst others have found significant correlations between the preferences of parents and their offspring (Pliner, 1983; Rozin *et al.*, 1984; Pliner and Pelchat, 1986), including for certain fruits and vegetables (Gibson *et al.*, 1998). Rozin reported variable correlations of parent-child similarities depending on the food in question (Rozin, 1991; Rozin *et al.*, 1984). However, some studies have disputed the notion of familial resemblances in food neophobia, both between parents and between siblings (Pliner and Loewen, 1997; Koivisto and Sjoden, 1996).

Children's vegetable consumption is likely to also be affected by the barriers to their parents' own consumption. The belief that they are already consuming adequate

quantities of vegetables prevents many adults from achieving the recommended dietary targets (Cox *et al.*, 1996; Marshall *et al.*, 1994; Leather, 1997). Parents may believe that their children are also consuming adequate fruit and vegetables. Further barriers to increasing vegetable intakes were apparent in one study where participants perceived vegetables to be less healthy/nutritious, less convenient (e.g. required preparation), and less popular with their family than fruit (Cox *et al.*, 1996).

Parents may also lack the knowledge and skills needed to prepare vegetables, often limiting them to a small number of 'favourites' (Leather, 1997; Marshall *et al.*, 1994, Anderson *et al.*, 1994c). The perceived expense of vegetables (Cox *et al.*, 1995; Marshall *et al.*, 1996), the weight of vegetables when carried any distance (e.g. walking home from the shop, up stairs in tenement buildings), the non-availability of good quality produce in low-income areas and the lack of promotion/marketing of vegetables (Leather, 1997) also contribute to low consumption among adults; therefore are likely to impact upon children's consumption of vegetables.

Parents and their attitudes towards foods certainly influence children's food acceptance habits (Rozin, *et al.*, 1984). Parents choosing not to eat a particular food because they dislike it could find that their children mimic their behaviour. Also, at a practical level, if a parent does not like a particular food, or does not know how to prepare it, they may not buy this food and therefore deny the child an opportunity to expand their taste horizons. A study of primary school children in the US found that the most significant factor which influenced the foods that the children ate was whether parents served the food at home (Michela and Contento, 1986). This may be because children of this age are unwilling to try a novel food in an environment which is less comforting than that of their home.

As many adults in Scotland are low (or no) vegetable consumers, the aforementioned research suggests that they could be restricting their child's vegetable consumption to a limited number of varieties, and are not teaching their children to consume the recommended (WHO, 1990; SOHHD, 1993) daily quantity of vegetables. Any barriers to

an adult's consumption of vegetables are also likely to have an impact on their children's intake.

2.5.3.8 Changing food patterns

The way in which we in the UK now purchase, prepare and eat our meals has had a detrimental effect upon our consumption of vegetables (Leather, 1997). As large retailers have located in out-of-town sites, many of us use our cars to do a 'big shop' once a week rather than shopping on a more frequent basis. As some vegetables have a relatively short shelf-life, our typical purchasing habits inevitably mean that there is wastage due to microbial spoilage (Leather, 1997). This may prevent consumers from purchasing sufficient vegetables to meet the dietary recommendations.

Our growing reliance upon convenience foods means we are less likely to cook from scratch using fresh ingredients and consequently, Leather (1997) believes our vegetable intake is reduced. Snacking, or 'grazing', is also a relatively recent eating trend in the UK, which potentially limits the consumption of many vegetables because meals consisting of 'meat and two veg' are now less common (Leather, 1997). Studies by Anderson *et al.* (1994a and 1994c) and Ruxton *et al.* (1996) show the prevalence of snacking among children and teenagers in Scotland, with high-fat, high-sugar manufactured snacks being the preferred choice. As a result of advertising and attractive packaging, parents are pestered to purchase branded goods, and children often refuse to eat own-label alternatives (Save the Children, 1997), making it more likely that children will wish to snack on confectionery products rather than healthier alternatives such as fruit or raw vegetables.

In an attempt to encourage children to request healthier snack items, the multiple retailer Sainsbury pioneered the sale of a range of mini fruits and vegetables (e.g. baby tomatoes, carrots) which are sold in 'child-friendly' packaging. These are designed as products for playtime snacks and for children's lunch boxes, and will compete alongside the packaged crisps and confectionery items more frequently chosen. On the basis of an earlier piece of

research (Rousseau, 1983) into desirable properties of children's 'playpieces', these added-value miniature vegetables should be an attractive option. They are bite-sized, able to be hand-held and do not interfere with playing; all requisite qualities in a 'playpiece'. Additionally, the packaging may make them a more desirable option as compared to home-prepared vegetables

2.5.3.9 Socio-Economic Factors

A further factor that can influence a child's consumption of vegetables is the socio-economic status of their family. Low-income families have been found to reduce their food expenditure when money is tight, often by buying less fruit and vegetables than usual (Leather, 1993). This is a cause for concern, as it has been widely reported that those of lower socio-economic status already consume significantly less fruit and vegetables than individuals of higher socio-economic status (Forsyth *et al.*, 1994; MAFF, 1996 and 1997; Shepherd *et al.*, 1996; SOHHD, 1993). Children from these low-income households are therefore likely to have a low vegetable intake as a result of their parents' modest food budget. It is equally likely, based on the theories cited previously (Rozin *et al.*, 1984; Sullivan and Birch, 1990; Birch *et al.*, 1980), that the children's vegetable acceptance habits will be shaped by their parents' example (i.e. vegetables are not viewed as a necessity) and the child's limited experience with different varieties.

Interestingly, it has been found that during the week surveyed for the National Food Survey (MAFF), participating households buy more food than usual (cited in Leather, 1992). The largest increase in food purchases is found among the low-income groups, which Leather suggests to be due to embarrassment over the paucity of their food intake, or the 'unhealthiness' of their diet. This leads one to speculate that the figures taken from the NFS for household vegetable consumption include a degree of over-reporting. So in fact, household vegetable consumption among the lower-income groups is probably lower than that actually recorded, although by how much is unknown. Despite these 'inaccuracies', it has also been reported using 1990 NFS data that the richest 20% of the population consume 20% more fresh green vegetables, 70% more fresh fruit, and 400%

more fruit juice than the poorest 20% (Leather, 1992).

The Scottish government have been trying to address the issue of poor diets and related health risks among low-income families. The 1999 White Paper on Health ('*Towards a Healthier Scotland*' Scottish Office Department of Health; SoDoH, 1999) is particularly committed towards improving the health of children, while also tackling poor health related to low social status.

The earlier Green Paper, *Working Together for a Healthier Scotland* canvassed the views of 800 people throughout Scotland. Addressing inequalities in health between socio-economic, geographical, ethnic, gender and other groups was found to be a priority among the people interviewed. Tackling the high incidence rates for coronary heart disease and cancer was another priority. An additional area of concern to those people consulted was the poor health of children in certain segments of the population, particularly those from low-income households. The national priorities as a result of the Green Paper were to improve life circumstances, improve lifestyles, and to address key health topics (including child health), all under the umbrella of tackling inequalities.

The White Paper has highlighted the link between good health in early years and improved health in adulthood. The health of children is a priority in the White Paper, and the National Health Service (NHS) have echoed this in their Priorities and Planning Guidance 1999/2002 (as reported by the SODoH, 1999). The Government will establish four health demonstration projects, including "Starting Well" which will focus on promoting health and protection from harm up until the age of five years old (SODoH, 1999). Aims of this project include encouraging taste preferences for foods that encourage a healthy diet in later life.

According to the 1999 White Paper, diet is second only to smoking as the most significant cause of Scotland's poor health. The inadequate diet of low socio-economic status households is recognised as a major factor in their particularly poor health

(SODoH, 1999). The Green Paper consultation found strong support for the continued implementation of the strategies set out in the *Eating for Health: A Diet Action Plan for Scotland* (SODoH, 1996). Actions to introduce a healthy diet from a young age, and to improve access to healthy foods (at affordable prices) in areas of social deprivation and in rural areas were also requested during the consultation period. The White Paper (SODoH, 1999) recognised the efforts of the Scottish Community Diet Action Project in improving the diets of those in deprived communities, whilst also applauding efforts by the major retailers to provide healthier alternatives at reasonable prices in such areas.

Those families who can be classified as 'low-income' make up a significant proportion of the UK population. In 1995, the number of people in the UK dependent on Income Support was 9.7 million, 2.2 million of whom were children under the age of 10 years (National Food Alliance, 1997). A 1993 study by the Family Budget Unit at York University suggested that a modest but sufficient diet for a family comprising two adults and two children under the age of 11 would cost £58.14 per week. However, the estimated allowance for food encompassed by State benefit was £39 per week for this family unit (National Food Alliance, 1997). It is therefore not too surprising that, given the food allowance shortfall, the diets of children of low socio-economic status do not fulfil their energy requirements, causing many of them to be below average height for their age (cited in Leather, 1992; Department of Health, 1989).

Recently, it was reported that three-quarters of Glasgow schoolchildren are entitled to free school lunch (National Heart Forum, 1997b, p.46), meaning that their parents cannot afford to provide midday meals for their child. It would not be surprising if these parents also perceived buying enough fruit and vegetables to give their children five portions per day as being too expensive for their modest food budgets.

A National Children's Home survey of 354 low-income families (NCH, 1991) found that just 40% of the children surveyed (aged under 5 years) ate green vegetables/salad "most days". The report also noted that an additional £1.64 (1991 prices) would be required by

families to purchase the necessary quantities of fruits and vegetables to meet dietary recommendations. This represented a 39% increase in the family's food expenditure. Additionally, the NCH report found that the largest difference in price between a 'healthy' and an 'unhealthy' shopping basket was to be found in Scotland. The same NCH report also stated that when low-income mothers were asked how they would spend an extra £10 on food for their child, 38% of respondents spontaneously said they would purchase extra vegetables, salad, or potatoes (not chips). Surprisingly perhaps, given these results, only 6% of the respondents cited cost as the reason for their child not consuming salad or green vegetables (NCH, 1991).

Concern that children might reject particular unfamiliar vegetables and therefore go hungry is said to prevent some low-income parents from purchasing a variety of vegetables because they cannot afford food wastage (Dowler and Calvert, 1995). This suggests that it is lack of income, not necessarily lack of knowledge of the benefits of consuming vegetables, which is partly responsible for the low consumption rates among many children from low-income families.

A further barrier to the consumption of sufficient fruit and vegetables by low-income families is the availability of an affordable, yet appetising supply of different varieties. Multiple retailers, with their high quality produce and discounts due to their bulk-buying power, are rarely found in close proximity to areas of deprivation, preferring to locate near main road networks in areas near to high-earning households (Anderson *et al.*, 1996, Leather, 1992). Low socio-economic status consumers are less likely to be car owners or to have the large freezers or storage space necessary to benefit from one-trip bulk-buying at these multiples, which covers the cost of the petrol or public transport costs incurred in the journey.

Those multiple retailers that do locate in low-income areas may charge more for 'healthy' items (which would include fresh vegetables) than their counterparts in the well-heeled areas. This can be illustrated by a 1995 survey comparing the price of food in several supermarkets in both affluent suburbs and deprived inner-city areas of London, finding that the cost of a 'healthy' basket of shopping was more than an 'unhealthy' basket in

both areas. However, the price differential between the healthy and unhealthy basket was greater in the deprived areas (a 20% increase) than in the affluent suburbs (16%) (cited by National Food Alliance, 1997). An earlier study of the cost of an adequate diet conducted in two socially disparate areas of Edinburgh found similar results, with corner shops in both areas also costing 20% more than the supermarkets (cited in Leather, 1992).

Healthy foods have also been shown to increase in price by a greater amount than less healthy foods. Leafy green salad was found to have increased in price by 86% in the period between 1982-1995, compared to a 54% price rise for chocolate biscuits, or a 37% increase for sausages (National Food Alliance, 1997).

Many low-income communities have established schemes to improve their residents' access to fruit and vegetables. Foster and McColl (1997) mention some of the Scottish schemes, including local co-operatives and healthy eating projects operating within areas of social deprivation.

Whilst financial restrictions probably do impact upon the vegetable consumption of children from some low-income households, other reasons must account for the 94 per cent of the NCH survey respondents who did not cite cost as the reason for their child's non-consumption of vegetables (NCH, 1991). Additionally, judging by the average household consumption data (MAFF, 1995 and 1996) there are many children refusing to consume vegetables (or consuming insufficient quantities) that are from households where money is no barrier. Therefore other factors must be inhibiting the consumption of the recommended quantities of vegetables for a significant proportion of Scottish children.

2.6 Opportunities to Increase Children's Vegetable Consumption

2.6.1 School Meal Provision

School meals are quite often an important source of essential nutrients for children from

low-income families, supplying a regular vegetable serving for the child, which the parents often cannot afford to provide (Dowler and Calvert, 1995). The role of schools in health promotion has also been recognised by the Scottish government's White Paper on Health (SODoH, 1999) which encourages schools to make health education an all-embracing concept involving curricular and extra-curricular activities. This includes the provision of healthy school meals, and it is obvious that school meals can be a vehicle for improving children's diets in areas of deprivation. However under the 1986 Social Security Act, families that were on Family Income Supplement (Family Credit since 1992) lost their right to free school meals for their children (Leather, 1992). This Act reduced the number of children taking school meals from 64% in 1974 to 47% in 1986, with most families now providing a 'packed lunch' from home (Rose and Falconer, 1992).

The role that school meals can play in the provision of a healthy diet for children has recently been recognised. However, a 1975 DES Working Party on Nutrition in Schools had noted that "*a nutritious meal will benefit pupils only if they eat it. Authorities should therefore ensure that their meal planning takes account of the likes and dislikes of the children in their schools*" (cited in Rose and Falconer, 1992). The Diet Action Plan for Scotland (Scottish Office Department of Health, 1996) recommends as one of its action points that "*in relation to meals provision in primary schools, the opportunity to provide, at all meals, a limited range of menus with vegetables and fruit included in the price of the meals should be explored as a matter of priority*" (p70).

Leather (1997) suggests that the emphasis on price margins and competitive tendering within the school meals sector has meant that plate wastage is no longer 'affordable'. In other words, providers of school meals cannot afford to offer meals that are not eaten, and Leather hypothesises that school catering therefore acts as a barrier to vegetable consumption among children.

Despite Leather's hypothesis, school meals, free or otherwise, could be utilised as a daily

source of vegetables for all children, regardless of socio-economic status, who otherwise might not consume any. School meals also offer an opportunity for low vegetable consuming children to witness their peers eating vegetables which may positively influence their attitudes towards vegetable consumption. Additionally, the role of school meals as a provider of balanced, nutritious meals for low socio-economic status children should be realised if the diets of disadvantaged children are to be improved.

2.6.2 Food Advertising

Despite the best intentions of any school to encourage their pupils to eat healthily, it is the parents who have the most vital role in teaching their children good dietary habits. But however much influence the parents have over their children's diet, the power of food advertising on shaping children's food requests and preferences should not be underestimated.

Advertising has been shown to be a major influencing factor in children's food habits, with heavily advertised foods being more frequently requested by children than those which have minimal, or no advertising (Donkin *et al.*, 1993, Gorn and Goldberg, 1982). Research has also shown that the majority of food advertisements shown during children's television programmes are for high-fat, high-sugar products (Dibb and Castell, 1995). 1993 figures show that £70 million was spent advertising chocolate confectionery, and £20.1 million advertising crisps and snacks compared to a spend of £2.9 million on advertisements for fresh fruit and vegetables (Leather, 1993).

A comparative study of food advertising aimed at children was recently undertaken in thirteen developed economy countries (Australia, Austria, Belgium, Denmark, Finland, France, Germany, Greece, Netherlands, Norway, Sweden, United Kingdom, and the USA) by Consumers International (1996). In the majority of the countries the category of products most frequently advertised to children on terrestrial television channels was food. Of the European countries studied, Britain had the highest level of food advertising aimed at children under 12 years of age. More than half of the food advertisements in all

countries were for confectionery, breakfast cereals (usually sweetened) and fast-food outlets, whilst advertisements for 'healthy' foods (including fruits and vegetables) were very infrequent, if existent at all. Britain, along with Greece, had the highest proportion of confectionery advertising of all the thirteen countries (Consumers International, 1996).

In 1995, the UK Independent Television Commission (ITC) bowed to pressure from consumer and health promotion bodies (including the National Consumer Council, British Dental Association, Health Education Authority, and the National Food Alliance) and introduced a new section in its code on food advertising (Consumers International, 1996). Essentially, the ITC acknowledged the impact that food advertising can have on children's dietary practices, but rejects the notion that competitive food advertising has the same role to play as education and public information in the education of consumers with respect to healthy eating. However, the ITC agreed that food advertisements "*should not undermine progress towards national dietary improvement by misleading or confusing consumers or by setting bad examples, particularly to children*" (Consumers International, 1996).

2.7 Awareness and Measurement of the Perception of Texture

2.7.1 Physiological

In an early report, Szczesniak and Kahn (1971) relayed the importance of human physiology with respect to the ability of an individual to perceive texture. To be fully able to control and swallow food in the mouth, we require the use of the muscles associated with the tongue, face and the movement of the jaw, plus teeth with adequate surfaces for shearing, tearing, chewing. The importance of physiological development to children's perception of texture was discussed in a later paper (Szczesniak, 1972). It was suggested that the physiological steps might influence children's attitudes to food texture at differing stages of their development.

More detailed reviews of the influence of dentition and physiology on the perception of

food texture can be found in Boyar and Kilcast (1986) and Christensen (1984).

2.7.2 Consumer Awareness of Texture

Textural awareness is an indication of consumers' consciousness of this attribute in relation to their food likes and dislikes. A study by Szczesniak and Kleyn (1963) using word association tests revealed that texture awareness depended on gender, technical background, and the sensory characteristics of the food product. The foods that prompted the most texture responses were either lacking in flavour or were of a crunchy or crispy nature. Most respondents were able to define texture only in terms of a food's moisture content, degree of hardness, or cohesive properties.

This study was subsequently repeated (Szczesniak, 1971) using members of the general population not associated with the food industry. This time socio-economic class was also found to influence awareness of texture, with a higher income bracket indicating a greater textural awareness. As with the 1963 test, consumers gave more texture responses to foods that were bland, or crispy.

Generally speaking, texture seems to be a food attribute that the consumer is only aware of on a subconscious level, this being especially true of people from a lower socio-economic group. Both the 1963 and 1971 studies indicated that people know that foods have a texture, but are often unable to verbalise their perceptions, or cannot distinguish it from other food attributes. If a texture term is defined, consumers appeared to have no difficulty in recalling foods which display these properties (Szczesniak and Kahn, 1971).

In a study of children and teenager's awareness of texture (Szczesniak, 1972), the older age group were found to be particularly conscious of texture as compared to their adult counterparts. The younger children displayed distinct preferences for certain textures (e.g. crisp, crunchy), and strong disliking for others (e.g. stringy, slimy). Some textures (soft, hard, and mushy) were cited both as liked and disliked textures, indicating that there is a role for appropriateness of certain textures depending upon the circumstances, or the

actual food involved (e.g. mushy vegetables are unappealing whilst mushy ice-cream is pleasant).

Teenagers in the 1972 study mentioned vegetables most frequently as foods that have unpleasant textures. Characteristics mentioned as unappealing included mushiness, softness, and stringiness. Spinach, asparagus and celery were amongst the most disliked foods cited, with the latter two both possessing fibrous qualities which could be construed as 'stringiness'. When the teenagers talked about foods with desirable textures, vegetables were rarely mentioned. On the few occasions that they were, carrots, celery and salads were listed as vegetables with pleasant textures. Assuming that it was raw carrots that were in mind along with the others, these vegetables share the characteristic of crispness/crunchiness, the attribute that is favourably perceived (Szczesniak, 1972).

Previously, the flavour and colour of products were seen as being of optimal research importance as texture variations were believed to be generally tolerated by the consuming public (Szczesniak, 1979). Indications of the importance of texture to consumers (e.g. Szczesniak and Kleyn 1963; Szczesniak, 1971; Szczesniak and Kahn, 1971; Szczesniak, 1972) lead to further research to produce reliable instrumental and sensory measures of food texture. Brennan (1984) provides a review of such research.

2.7.3 Non-Sensory Methods of Texture Evaluation

Instrumental methods for the study of texture have been used for several decades, and are discussed by Brennan (1984) and Bourne (1982). The main difficulty with such methods of texture measurement is the relationship between the instrumental readings and sensory perception of texture. Ideally any instrumental method of measuring food texture should correlate as closely as possible with human oral or non-oral texture evaluation methods. Thus, much research has centred on the correlation between instrumental and sensory data.

Univariate and multivariate methods of relating sensory and non-sensory methods of

texture are briefly discussed by Brennan (1984). Multivariate analysis allows the study of more than one sensory attribute to be related to instrumental data, and includes methods such as principal co-ordinates analysis (PCO), principal components analysis (PCA), and discriminant analysis. Naes and Risvik (1996) and Piggott (1986) provide further details of the use of these procedures with sensory data.

2.7.4 Non-Oral Texture Evaluation

Consumers are able to make quite accurate judgements of the texture of foods prior to mastication. Children (and others) may use these judgements when deciding whether or not to consume particular vegetables. It has earlier been suggested that actual consumption of a food is necessary to reduce taste neophobia (Birch *et al.*, 1987; Sullivan and Birch, 1990), so unappealing non-oral textures may inhibit a child's vegetable intake.

The visual appearance of foods can be an indicator of the texture. For example, the colour of some fruits and vegetables can be used to gauge how ripe they are, and hence their firmness. Also some vegetables which are particularly susceptible to turgor loss, such as lettuce, spinach and fresh herbs display loss of crispness by a limp appearance.

Deformation of fruits and vegetables can give an indication of the firmness of the product, with the firmness of carrots being assessed by flexure tests (Abbott, 1972).

Puncture tests using eating utensils or fingernails reveal how tough the skins of fruits such as pears and tomatoes are, and also give clues regarding the firmness of the flesh of all fruit and vegetables. Bourne (1982) gives a good account of some non-oral methods of sensory measurement of texture.

2.8 Methodology for Assessing Sensory Perceptions of Products

2.8.1 Background

The evaluation of the sensory properties of a product usually involves a trained sensory panel. Expert panellists (e.g. cheese graders, tea graders or wine tasters) can also be used, but their expertise tends to be restricted to only one particular product category, whereas

a trained panel can be re-trained to evaluate a number of products.

Sensory profiling methods using trained panels are commonly used in industry and in research (Meilgaard *et al.*, 1991). Conventional sensory profiling is essentially Quantitative Descriptive Analysis (Stone *et al.*, 1974).

2.8.2 Quantitative Descriptive Analysis

Quantitative Descriptive Analysis (QDA[®]) is an offshoot of Cairncross and Sjöström's 1949 flavour profile method. Both of these methods rely on a trained, but not necessarily expert panel to select the appropriate vocabulary to describe the products and profile them for their sensory characteristics. Profiling is done using a rating scale for each attribute, along which each product is scored.

Quantitative Descriptive Analysis requires the panel and the leader to work together to produce the vocabulary which all assessors must understand and use in the same manner to evaluate the product (Powers, 1984). A very intensive training period is necessary which obviously requires dedicated subjects who are able to spare the time to attend these sessions. With Quantitative Descriptive Analysis, the demographic background of the panellists is irrelevant, because essentially the panellists act objectively as an all-encompassing measure of all the sensory components of a particular product. There would therefore be no incentive to attempt to train a Quantitative Descriptive Analysis panel comprised of children as adults could provide the same information, probably with greater accuracy and less training.

2.8.3 Consumer Profiling Techniques

Consumer testing is an important way of providing information from the people that actually consume the target product. Typically, consumer testing involves either determining whether typical consumers of the product can detect any changes made to the product (difference testing), or getting them to score their liking/acceptance for it (preference testing) (Meilgaard *et al.*, 1991).

The Consumer Texture Profile Technique (Szczesniak *et al.*, 1975) allows detailed examination of consumers' perceptions of the texture of a product to be made, akin to Quantitative Descriptive Analysis. The descriptors used (the textural attributes under assessment) are compiled by a trained texture panel and the anchored rating scale chosen has been found to yield good results with untrained consumers. The technique was designed to provide more realistic (although still quantifiable) results than those available from highly trained and objective sensory panellists. The results from the Consumer Texture Profile Technique aim to inform manufacturers of the optimum textural characteristics for consumer acceptance of their products.

The method appears to be straight-forward, and Szczesniak *et al.* (1975) reported success when using the technique with untrained consumers to assess the texture of a variety of products. However, one potential problem in the use of this technique with child assessors, or in fact even with adult consumers, is that they may interpret the meaning of the textural descriptors in different ways from each other, or completely fail to understand the use of a particular descriptor. One method which sought to offer a solution to this problem, common to all descriptive profile work is free-choice profiling (Langron, 1983; Arnold and Williams, 1986).

2.8.4 Free-Choice Profiling

Free-choice profiling (FCP) is a more recent descriptive technique (Arnold and Williams, 1986) which has the benefit that it can be used with untrained consumer panels. Essential to FCP is the assumption that all assessors will perceive the same attributes with the same intensity, only differing in the way in which they describe them (Piggott *et al.*, 1989). The number of attributes ('descriptors') used to describe the product depends on the perceptual and descriptive ability of the assessor (Oreskovich *et al.*, 1991).

Compared to conventional profiling, FCP has the advantage of allowing the subjects to use their own descriptives to assess the sensory characteristics of a product, thereby

foregoing the need for prior training sessions. This suggests that a FCP method would be better suited to child panellists as the sensory leader would not need to ensure that they had reached a consensus with respect to the vocabulary used. Another advantage of FCP over conventional descriptive analysis is that the samples do not have to be compared with each other, further reducing the time required to profile a sample (Williams and Arnold, 1985).

2.8.5 Statistical Analysis of Sensory Data

Once the panellists have profiled the sample, both conventional profiling and FCP require them to score the intensity of each attribute using linear scales. As errors are more normally distributed with continuous data, Quantitative Descriptive Analysis utilises analysis of variance to produce information concerning the assessment of the product. Principal components analysis (PCA) (Piggott and Sharman, 1986) is often employed to give a graphical representation of the samples analysed, or more simply a post-hoc test can identify the samples/attributes that reveal significant differences and a spider plot can be drawn.

Free-choice profiling relies on generalised Procrustes analysis (GPA) (Gower, 1975; Langron, 1983) to eliminate any differences in the subjects' style of describing the product and also their use of scoring techniques and scales. Principal co-ordinates analysis (Piggott and Sharman, 1986) can then be applied to the data to reveal any inter-relationships between the samples and the assessors (Guy *et al.*, 1989).

FCP followed by GPA therefore offers a further advantage over Quantitative Descriptive Analysis, whereby the FCP panellists do not need be trained to score attribute intensities at the same level by the use of reference samples.

If FCP were to be used with a group of child panellists, using GPA to analyse the ensuing data would eliminate the need to intensively train the children on the use of linear scales. This would account for the reported use of different parts of the scale by children as

compared to adults (Moskowitz, 1994).

2.9 Use of Scales with Children

Children as young as 3 years have established food preferences that they consistently maintain when tested (Birch, 1979). Given the large number of food products on the market-place that are geared towards young children, techniques to reliably test the hedonic responses of children are important for food manufacturers. Inevitably, some type of scale suited to using with children will be required for the research to be presented in this thesis.

2.9.1 Types of Scales

Before embarking on any sensory evaluation work with child assessors, it is critical to determine the best scale for their use. Scaling involves the panellist indicating the relative intensity of a sensory attribute as a mark on a score sheet or scale, or by assigning it a numerical score. For Quantitative Descriptive Analysis work, the scales must be anchored (e.g. 'not at all' and 'extremely') and labelled with the attribute in question to ensure all panellists are using the same discerning qualities.

e.g. typical linear scale used in Quantitative Descriptive Analysis profiling:



Ideally for an untrained panel, descriptive terms are better used as intervals on the scale than numerical labels. Scaling generates data that has magnitude and direction with respect to inter-sample differences (Brennan, 1984), which arguably allows the sensory analyst to obtain more discernible information from the ensuing data.

2.9.2 Scales commonly used with children

Sensory testing using child assessors commonly utilises the 'child-friendly' hedonic

facial or verbal scales (e.g. Birch *et al.*, 1990; Kroll, 1990; Kimmel *et al.*, 1994). The length of these hedonic scales is selected according to the age of the child. Kimmel *et al.* (1994) and Kroll (1990) suggest that children aged 4 years and above can use a 7-point hedonic scale that uses categories, while Fallon *et al.* (1984) report the successful employment of a 5-point facial scale with children aged 3 ½ years old.

Chen *et al.* (1996) used facial hedonic scales selected according to the age of the children whose preferences for types of milk they were testing. The 3-4 year olds used a 3-point scale, those aged from 4 up to 5 years used a 5-point scale, and the 7-point scale was used with the children aged from 5 up to 6 years old. The researchers found that the 4 year-olds were unable to cope with hedonic facial scales that had more than 5-points, in contrast to the results of research by Kimmel *et al.* (1994) and Kroll (1990) that had used a 7-point hedonic scale. These results were interesting from the point that children below the age of 5 years are seldom used as assessors for sensory testing due to their limited cognitive skills, and short attention span (Chen *et al.*, 1996).

Moskowitz (1994) reported that children aged eight years and above were able to use linear rating scales that were verbally anchored at either end. The advantage of using unstructured linear scales rather than facial or verbal scales is that they do not limit the assessor to just the values provided as anchors on the scale, and greater discrimination between samples is therefore possible at the analysis stage. Using linear rating scales, data on children's perceptions of foods could be collected, rather than being limited to just hedonic responses. This would allow a more detailed analysis of a product aimed at children to be collected and affords opportunities for the research proposed in this thesis.

It has been suggested that children use a narrower range of the scale than adults, and that they tend to avoid the lower end of the scale (Moskowitz, 1994). However, the use of GPA to analyse data collected on linear scales would correct for differences between assessors' use of the scales and differences in the way that they score (Arnold and Williams, 1986), thus overcoming problems associated with children's scaling

techniques.

2.10 Methods for Obtaining Perceptual Information from Consumers

Consumer data can be collected using a number of methods, but essentially these can be either interviews or questionnaires, and can be structured or unstructured (Meiselman, 1994). Researchers who wish to elicit individuals' perceptions of the subject of interest (e.g. a food product, attitudes towards certain behaviours) commonly conduct focus group interviews; a type of unstructured interview (Casey and Krueger, 1994).

2.10.1 Focus Groups

Focus groups provide the researcher with the views of a group of selected consumers, while allowing the researcher (the moderator) to examine points of interest in further detail as they are raised. Researchers can also use focus groups to increase their sample size for qualitative studies without having to spend inordinate amounts of time conducting the interviews (in contrast to face-to-face interviews). However, moderators need training to be able to conduct focus groups, as encouraging the full participation of all the group members is not always straightforward (Casey and Krueger, 1994). A number of focus groups should be conducted to allow for the varying opinions of subjects from different groups. Partly because of the involvement of a number of different groups, information from focus group interviews can be difficult to analyse and considerably time-consuming. A further problem with focus group interviews is that recruiting the groups can be difficult (Casey and Krueger, 1994).

2.10.2 Questionnaires

Questionnaires can be used to obtain the opinions of a larger number of consumers than is possible in practice using interview methods such as focus groups (Robson, 1993). If the questionnaire is well constructed (i.e. through piloting it before sending it to the sample population), the amount of time necessary to code and analyse the results can be minimal (Robson, 1993). The researcher needs to be aware that the honesty of the responses can

be spurious, and that the response the consumer wants to give may not be possible due to the format of the questionnaire (Robson, 1993).

2.10.3 Sorting Techniques

Multiple sorting techniques (Canter *et al.*, 1985) allow researchers to categorise consumers' personal classification systems relating to particular stimuli such as foods. Consumers are given the samples of interest and asked to group them according to perceived similarities, giving adjectives to describe this perception. Sorting methods are easy for consumers to understand and have previously been used in studies of perceptions of meat (Steenkamp and Van Trijp, 1988) and a selection of foods including fruit and vegetables (Worsley *et al.*, 1980).

Repertory grid method (Kelly, 1955) is an interview technique that is similar to sorting methods. Individuals are asked to indicate ways in which a selection of the samples are the same or different as each other. Compared to sorting techniques, some researchers believe that repertory grid method (RGM) gives more reliable information (Schiffman *et al.*, 1981). Other researchers disagree, preferring to use sorting techniques instead of RGM (Canter *et al.*, 1985). However, reviewing the food appropriateness literature, the abundance of studies using RGM (McEwan, 1988; McEwan and Thomson, 1988; McEwan *et al.*, 1989; Piggott and Watson, 1992; Scriven *et al.*, 1989, Gains and Thompson, 1990; Raats and Shepherd, 1991/2; Jack *et al.*, 1994; Jack *et al.*, 1998, Jack *et al.*, 1997) suggests that it is a method well suited to studies of consumers' food perceptions. For this reason it will be considered in more detail.

2.11 Repertory Grid Method

2.11.1 Background

In 1955, George Kelly published a major work, *The Psychology of Personal Constructs*. Kelly's theory suggested that people strive to comprehend the world they live in and to

gain an understanding of their experiences/emotions. According to Kelly, we do this by interpreting (or construing) events that involve us, and we organise these interpretations ('constructs') in a manner unique to ourselves (Beail, 1985). The process of construing is akin to the discrimination applied in Quantitative Descriptive Analysis; essentially a person is differentiating between similarities and differences between events or one's feelings (e.g. perceptions of vegetables). An individual's constructs are then linked together in a complex, theoretical framework containing hierarchical systems and sub-systems depending on the importance attached to them (Beail, 1985). This is our personal construct system.

Kelly devised his repertory grid technique as a means to explore personal construct systems (Fransella and Bannister, 1977, Chapter 1), and to allow an individual's dominant constructs to be identified by mathematical relationships showing the degree of similarity between constructs, and/or elements (Kelly, 1955, p.307).

Repertory grid techniques basically utilise an interview technique and have three main components:

- (1) **Elements** that define the area of construing under investigation such as 'flashcards' of food products about which the subject is to be interviewed,
- (2) **Constructs** ('attributes') are the terms that a person uses to identify similarities and differences between the elements e.g. presence/absence of a physical attribute, and
- (3) **Linking mechanism** shows how each element is judged on each construct e.g. linear scales, which lead to the production of a multi-dimensional plot of the perceptual space.

2.11.1.1 Construct elicitation

RGM essentially requires the researcher to ask a subject to describe how they perceive the different elements (samples). The most typical method of eliciting constructs is by using the triadic method exploring three elements at a time (Beail, 1985). Kelly proposed this method, whereby the subject is asked 'In what important way are two elements alike

and thereby different from the third?’ and then ‘In what way does the third differ from the other two?’ Kelly additionally suggested that the triads be presented sequentially, retaining one element from the triad to carry over into the ‘new’ triad.

2.11.1.2 Completing the grid

Once all the personal constructs have been elicited, subjects need to indicate the correlation between each construct and their perceptions of the elements. Ranking or rating scales are used as a means of scoring the elements, indicating any differences between them. It was Don Bannister (1960; cited in Beail, 1985) who suggested that subjects be asked to supply labels for the two poles of each construct, which could then be used at the ‘scoring’ stage. For example, if a subject elicited the construct ‘happy’, the labels for their poles might be ‘happy’ and ‘sad’. By the use of ranking, elements can be placed at any position in-between these poles. Salmon (1976) reiterates the need for poles to be used for scoring, stating that “...*every judgement inevitably contains its opposite*”.

However, not all constructs have a natural opposite. For example, the opposite of ‘hard’ is not necessarily ‘soft’, as softness may be perceived to incorporate the moisture content, ease of breakdown in the mouth, etc. Potentially a further problem when using RGM with young children is that they may be unable to verbally describe the opposite of a construct, and may well describe the opposite of ‘hard’ as being ‘not very hard’.

2.11.2 The Use of Repertory Grid Method in Studies of Food Appropriateness

Kelly’s Personal Construct Theory (1955) was traditionally used in a clinical psychological setting where it was used to examine patients’ self-perception (e.g. Ravenette, 1975; Salmon, 1976; Fransella and Bannister, 1977, Chapter 1; Edwards, 1978).

Since the 1980’s, modified repertory grid techniques based on Kelly’s theory have been used to investigate consumers’ perceptions of food products. An early, published use of RGM in food studies examined consumers’ perceptions of meat (McFayden *et al.*, 1973).

Since then, further studies have utilised RGM to examine consumer's perceptions of a variety of foods, e.g. meat (McEwan, 1988; Thomson and McEwan, 1988), chocolate confectionery (McEwan, 1988; McEwan and Thomson, 1988; McEwan *et al.*, 1989), alcoholic beverages (Piggott and Watson, 1992; Scriven *et al.*, 1989, Gains and Thompson, 1990), milk (Raats and Shepherd, 1991/2), cheese (Jack *et al.*, 1994) and fruit as a snack (Jack *et al.*, 1998, Jack *et al.*, 1997).

2.11.3 Use of Repertory Grid Method with Young Children

The use of RGM with children in a clinical setting by educational psychologists, or child psychologists is well-established (Ravenette, 1975; Salmon, 1976; Fransella and Bannister, 1977, Chapter 1; Edwards, 1988). For example, the technique has been used for semi-structured interviews with children who have emotional problems, or who exhibit disruptive behaviour at school (Fransella and Bannister, 1977, Chapter 1).

Phillida Salmon wrote a particularly useful guide to the use of RGM with young subjects (Salmon, 1976), establishing that the grid method is a particularly flexible method, which can be modified to suit the requirements of the subjects. As Salmon states (p.21), subjects may be *"...a pre-school child or an adolescent, the grid may be administered individually or to a group of children, elements may consist of physical objects or verbal labels, constructs may be elicited or supplied, the subject's task may be to order the elements in some physical way or to record judgements clerically, and, finally, the sorting may be a simple yes/no allocation or a more elaborate judging procedure"*. It was also suggested that when working with child assessors the best elements (samples) to use are either real objects, or pictorial/photographic representations of these, rather than verbal or written descriptions (Salmon, 1976).

Typically with repertory grid studies, Kelly's triadic elicitation techniques (comparing three samples at a time) are used to obtain an individual's constructs. However, the dyadic approach (two samples) is recommended when working with children under the age of 10 years as it has been found to be a cognitively less challenging task (Ryle and

Lunghi, 1970; Allison (1972, cited by Salmon, 1976); Fransella and Bannister, 1977, Chapter 1).

It has been suggested that children do not manage “*to cope with material of a less concrete kind*” until they reach the age of eight years old (Salmon, 1976). This suggests that the formal dyadic elicitation method of construct generation used in RGM is unsuitable for children below this age. Salmon (1976) actually recommends that even for the dyadic approach, subjects be at least nine years of age. She also suggests that the number of elements (e.g. vegetables) be restricted to eight when child subjects are involved.

2.11.4 International Studies of Perceptions of Foods Using RGM

Repertory grid method has previously been used in studies of adolescents’ perceptions of foods, including fruits and vegetables. In Australia, Worsley (1980) used RGM to elicit constructs relating to fruit and vegetables from both nutrition and non-nutrition secondary-school students. A more recent study in the USA used RGM to correlate young adults’ perceptions of five fruit and vegetables (among 15 other foods) with their relative intake (Keim *et al.*, 1997). The fruit and vegetables included in this latter study included orange juice and French fries, with the other samples being broccoli, tomato and apple. However, from a survey of the literature conducted in March 1997 (using Food Science and Technology Abstracts, PsychLit, and the Social Sciences Citation Index CD-ROMs), it appeared that the repertory grid approach had not previously been used with young children to examine their perceptions of foods.

Note

Part of this chapter is based on a previously published paper:

Baxter, I.A. and Schröder, M.J.A. (1997). Vegetable consumption among Scottish children: a review of the determinants and proposed strategies to overcome low consumption. *British Food Journal*, 10, 380-387.

CHAPTER THREE: RESEARCH OBJECTIVES AND PLAN OF EXPERIMENTATION

From a review of the literature, it was concluded that the low vegetable consumption typical among Scottish children is of concern in relation to the potential long-term health implications of this behaviour. To successfully promote vegetable consumption to children, information about their perceptions of vegetables (both negative and positive) would be advantageous when planning health campaigns aimed at this age group. By additionally collecting preference data from the children and relating it to their perceptual data, a picture of the pleasant and unpleasant qualities that children associate with vegetables can be built up.

Additionally, the literature review suggested that further work was required to clarify the sensory methods suited for use with child assessors. In particular, there was some doubt as to the scales suitable for use with children, although this research does not propose to examine the use of scales across a wide age range.

The aims of this investigation are:

- To examine Scottish children's perceptions of and preferences for vegetables commonly available in Scotland.
- To identify and test a model (repertory grid method) for obtaining reliable perceptual data from child consumers.
- To identify whether children of an age group to be determined during the pilot study can use anchored linear rating scales rather than relying on facial/verbal hedonic scales.

- To examine the suitability of repertory grid method for use with children to assess their perceptions of vegetables.
- To investigate the influence of geographical location on children's perceptions of vegetables as a means of explaining the disparity in vegetable consumption between the residents of Edinburgh and Glasgow.
- To investigate the influence of socio-economic background on children's perceptions of vegetables as an explanation for the lower (or absence of) vegetable consumption among lower socio-economic groups.
- To examine any inherent differences in the perceptions and preferences of children who are high vegetable consumers and those who are low vegetable consumers, independent of geographical or socio-economic factors.
- To examine the importance of sensory factors, in particular textural, in relation to the consumption of vegetables among Scottish children.

CHAPTER FOUR: METHODOLOGY

4.1 Summary

Repertory Grid Method (RGM) was used to collect perceptual data relating to eight common vegetables from 23 primary school children in England during a pilot study to test the methodology. Once RGM was deemed to be a suitable method, data for the main study was collected from 94 primary school pupils in Scotland. The perceptual data was analysed using Generalised Procrustes Analysis (GPA). The children also provided preference ratings for the vegetables that were subsequently correlated with the perceptual constructs using Preference Mapping. Finally a questionnaire was presented to each of the children in the main study. This asked the children about their typical weekly vegetable consumption, familiarity with and preferences for the sample vegetables and also others that they could name, their consumption of vegetables at school and at home, and where the family typically bought their vegetables. A grid was also included to indicate how suitable the children believed each of the eight sample vegetables to be for eating in/as an accompaniment to nine common meals.

4.2 Participating Schools

Five primary schools participated in this research project; one in England and four in central Scotland. The English school was in a village to the south of Cambridge where the author had contacts and was used to pilot the methodology and determine the age group of the children for the main study.

The schools that participated in the main study were purposively selected (Diamantopoulos and Schlegelmilch, 1997; p.14), that is they were chosen because they were in a certain city in an area where the residents were of a particular socio-economic background to meet some of the aims of this research. The schools were not randomly selected. Instead, the author used contacts within schools that matched the selection criteria (city and DEPCAT score for the surrounding area) to gain access to the schools.

Four schools in central Scotland took part in the main study; two of which were in Edinburgh, and two in Glasgow. The schools were chosen to represent geographical variation (East Coast versus West Coast) and socio-economic variation (affluent versus deprived). As reported earlier in Chapter 2 there are marked differences between the two Scottish cities with respect of their residents' vegetable consumption. It is also the case that families of higher socio-economic status consume more vegetables on average than those families of low socio-economic status.

4.2.1 Selecting Schools on the Basis of Socio-Economic Status

Schools in socially disparate areas were chosen in each of these two cities, selected using the deprivation categories (DEPCAT) assigned to the relevant postcode sectors (Carstairs and Morris, 1991) combined with information from the relevant city councils regarding Priority Partnership Areas (PPAs). Every postcode sector in Scotland has been assigned a DEPCAT ranging from 1 = most affluent, to 7 = most deprived. DEPCATs are based on indicators used by the Scottish Development Department to assist planning, and are calculated on the basis of four variables:

1. Overcrowding – persons in private households living at a density of >1 person per room as a proportion of all persons in private households.
2. Male unemployment – proportion of economically inactive males who are seeking work.
3. Low social class – proportion of all persons in private households where the head of household is of social class IV or V.
4. Absence of car – proportion of all persons in private households with no car.

Each variable was believed to be a determinant of material disadvantage (Carstairs and Morris, 1991). It is of interest to note that 50% of the Glasgow population live in sectors within the two most deprived categories (DEPCAT 7 and 6) whilst Lothian health board (Edinburgh) has the highest number of postcode sectors at the affluent end of the scale (DEPCAT 1 and 2).

Since April 1st 1996, the Scottish Councils have been at district level (they were previously at a regional level). PPA's (previously known as Areas of Priority Treatment) are used by the councils to categorise areas as Priority 1, 2 or 3 according to the size of the population within the area who are deprived, and the severity of that deprivation. PPAs competitively bid for EC Urban Programme Funds against other PPAs (both within and outside of their own district) to improve the standard of living for their residents.

Within Glasgow City (as of June 1996) there were 7 PPAs. Areas that have already received funding are not included, even if they are still classified as an area of deprivation (e.g. Castlemilk). The 7 PPAs at the time when the Urban Regeneration Group at Glasgow City Council were contacted were: Greater Easterhouse, Govan, Gorbals, Drumchapel, Greater Pollok, the East end, areas of Glasgow North,

The City of Edinburgh Council provided a list of Primary Schools situated within PPAs, taken from their publication 'Closing the Gap'. Approved PPAs at that time (November 1996) were: Craigmillar, Greater Pilton, Prestonfield, Wester Hailes. Six further areas were proposed as PPAs; Southside, Leith, Oxcgangs, Broomhouse, Restalrig/Lochend, Moredun and Burdiehouse. Unlike DEPCATs, PPA's do not go down to the level of a street but cover a larger area bounded by postcode sectors. By combining information from both methods of categorisation, it was possible to select disadvantaged schools located within PPAs in each city that had DEPCAT scores of 7. The advantaged schools were chosen using the DEPCAT scores (DEPCAT1) and on the basis that none of the pupils on the school roll were eligible for free school meals. All the pupils at the disadvantaged schools were eligible for (and received) free school meals.

The use of DEPCAT scores as the measure of the socio-economic background of the participating assessors does have some limitations. A postcode sector can be a large area and the assigned DEPCAT score does not account for the household income of individual dwellings. Households within the DEPCAT areas selected for this study may have been

incorrectly classified with either too high, or too low a deprivation score. Alternative measures of the SES of the children could have included household income level or parental occupation. However, it was thought to be too sensitive to ask the children's parents/guardians for information regarding their income level. Parental occupation as an indicator of SES can also be problematic, with misleading job titles (e.g. the over-frequent use of the title 'manager'), and difficulty classifying people such as 'housewife/homemaker' and 'unemployed' where people in both of these groups may be either educated professionals or long-term unemployed. Also, asking 8-year-old children about their parent's occupation was not thought to be reliable, whilst sending a questionnaire home for the parents to provide this information was thought to be intrusive and it was likely that a certain percentage of the children would not return this information. By using DEPCAT scores combined with local knowledge (the author had lived in both cities chosen), schools within areas that were thought to fairly represent either a DEPCAT 1 or a DEPCAT 7 score could be selected.

Once the four schools had been selected, their respective head teachers were approached for permission to conduct the research in their schools. Parental consent was requested at the two disadvantaged schools (at the request of the head teacher). The appropriate contacts at the Education Departments for the relevant city council were also approached for permission. The proposed research had already been cleared by the Queen Margaret University College Ethical Committee.

4.3 Assessors

4.3.1 Sampling of the assessors

The assessors who participated in this research were selected using purposive sampling (Diamantopoulos and Schlegelmilch, 1997; p.14), that is they were chosen because they were of a particular socio-economic background, lived in a certain city and were of a certain age. Studies using RGM typically involve just 20 consumers from each homogenous portion of the sample population (Scriven *et al.*, 1986). Therefore for

purpose of the research presented in this thesis, schools were selected on the basis of the main factors under examination (socio-economic status and city of residence) and within each school a class of between 20-25 pupils were randomly chosen by the headteacher. Overall, approximately equal numbers of children from each city, and each socio-economic background were chosen, while also ensuring an approximately equal split between males and females.

4.3.2 Assessors Participating in the Pilot Study

A total of 23 children participated in this study conducted in a primary school in Cambridgeshire. The children were chosen at random from the class lists, with the only criteria being approximately equal numbers of males and females. The age group of the children was selected mainly on the basis of a previous researcher's experiences of using RGM with children in a clinical setting. Salmon (1976) suggested that a child as young as six years old could cope with various kinds of rating measures (e.g. scales). Other factors influencing the age of the assessors to be used for the research presented in this thesis were determined by reviewing the results from previous studies in which children used rating scales, as well as information relating to the different stages of children's cognitive development (Piaget, 1952; Ault, 1983).

The ages of the children in the pilot study varied between 8-11 years (mean age 10 years, 3 months), as one objective of the pilot study was to confirm the age group for the assessors to be used in the main study.

4.3.3 Assessors Participating in the Main Study

A total of 94 children took part in the main study, although complete data was available for only 91 of these children. The ages of the children ranged from 8 years 2 months to 10 years 5 months (median age 9 years 0 months). Forty-six of the assessors were female, and forty-five were male. The demographic details of each assessor in the main study are shown in Appendix 1.

4.4 Samples

4.4.1 Samples (Vegetables) Used in the Pilot Study

A total of eight samples are recommended for RGM studies using child assessors (Salmon, 1976). Fifteen vegetables were initially selected for the pilot study using available 1995 consumption and sales data (Mintel, 1996; MAFF, 1995). These were then narrowed down to eight on the basis of familiarity to 11 children (known to the author) aged 9-11 years. Laminated, labelled photographs of the eight selected vegetables (cooked carrot, raw carrot, sweetcorn, peas, cucumber, celery, capsicum (bell peppers), and mushrooms) were used. Because of the anticipated significance of texture to the children's perceptions, the carrots were represented as both raw and cooked.

Using labelled photographs of the samples in place of the assessors actually tasting them had many advantages. It was believed that the preparation method could influence the children's perceptions of the vegetables (e.g. they might have no previous experience of that preparation method, they might dislike the vegetables prepared in that particular way, or they might limit their discussion only to that preparation method presented to them). By using photographs as 'prompts' rather than having the children tasting the samples, the schools, local education authorities and parents were more willing to allow the children to participate. Problems with preservation and transportation of the samples to the study schools were alleviated by the use of photographs, as were potential difficulties of sample standardisation between assessors. A final factor that influenced the decision to use photographs was the assumption that the co-operation of the children would be easier to obtain if they knew that they would not have to eat anything that they disliked.

4.4.2 Samples Used in the Main Study

By the time the data collection in the Scottish schools was organised, more accurate data relating to Scottish consumers' consumption of vegetables was available from a Special Report in the 1995 National Food Survey (MAFF, 1996). Based on this information, some changes were made to the samples, and the final eight chosen on the basis of the

most commonly consumed vegetables in Scotland were: Baked beans, carrots (not specifically labelled as raw or otherwise), tomatoes, cauliflower, cabbage, turnip, peas, and sweetcorn. Cauliflower and cabbage were the most frequently consumed fresh green vegetables in the UK (according to Table 5.1 of the 1995 National Food Survey); turnip was chosen because of its popularity in Scotland for use in soups and as an accompaniment to the traditional haggis supper. Tomatoes were chosen because of their versatility (e.g. soups, sandwiches, pasta sauces, salads) with the assumption that all the children would be familiar with them. Carrots and canned beans (taken as meaning 'baked beans') were the most consumed vegetables overall (excluding potatoes) according to the 1995 National Food Survey data. Peas and sweetcorn were chosen to represent vegetables which could be eaten in either the fresh, frozen or canned form, therefore being likely to be consumed by children irrespective of SES.

4.5 Procedure for the Collection of the Perceptual Data

4.5.1 Repertory Grid Method to Elicit Constructs

The procedure was the same in the pilot and main studies. Initially the children were interviewed individually using Kelly's RGM. This entailed asking each child to examine the eight photographs of the samples and to choose two (the dyadic approach to RGM), describing any way in which this pair were similar or different. To give each child time to relax and gain confidence with the interviewer (the author), they were allowed a 'free rein' to mention anything for the first few minutes. If necessary, after this time, the interviewer asked them to concentrate on how the vegetables were the same/different in terms of "what they are like to eat". This tended to elicit attributes relating to the sensory qualities. They were then asked to compare and contrast the pair in terms of "how or when you would eat them" which typically elicited attributes relating to the meals with which the vegetables were eaten.

Once the assessor had exhausted their responses for the first pair of photographs, the child was asked to discard one photograph and make a new pair from the remaining

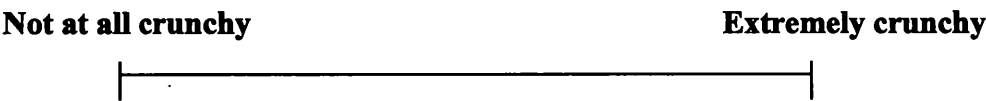
photographs. This procedure was repeated until no further new constructs were generated. In this way, each assessor built up a vocabulary of personal constructs relating to the samples. No taste-testing took place with the children at any time; all the information related to their perceptual recall.

RGM was thought to be a more suitable interview technique than methods such as focus groups (for details on focus group interviewing, refer to Casey and Krueger, 1994), as the interviews were on an individual rather than a group basis. This made it unlikely that dominant children would influence the others, and also ensured that every child fully participated in the study by generating some perceptual attributes.

4.5.2 Scoring of Personal Constructs

Assessors were given personalised score sheets containing linear scales representing each of their constructs. The terms “not at all...” and “extremely...” anchored the scales. An example is shown below:

Q. How crunchy are the vegetables?



Fifteen-cm linear scales were used in the pilot study, but 10cm linear scales for the main study. The reason for this difference was purely due to the design of the score sheets.

The pilot study aimed to establish whether children of this age group could use linear scales in a satisfactory manner, as had been intimated by Moskowitz (1994), rather than the more commonly used ‘child-friendly’ facial or verbal hedonic scales (e.g. Kimmel *et al.*, 1994; Kroll, 1990).

Examples of typical constructs were used with the assessors to demonstrate how to

complete the scoring, using fruits as the samples to avoid influencing the assessors. Once the assessor had grasped the concept, they scored all eight vegetables using one scale for each of their constructs. Therefore the children were making relative judgements about each vegetable compared to the other seven vegetables for each attribute.

A maximum of 23 constructs could be scored, as dictated by the length of the score sheet which was limited to five pages. This corresponded to the number of pages that the 11 'pre-pilot' children (used to test familiarity with the pilot vegetable samples) would complete without becoming restless.

Additionally, each score sheet included a linear anchored preference scale to measure the assessors' liking for each of the vegetables. Birch and Sullivan (1991) and Contento (1991) suggest that food preferences are reliable indicators of children's actual consumption. The order of the hedonic question on the scoresheet was randomised across the assessors to reduce bias due to previous questions (Earthy *et al.*, 1997) which may have drawn the child's attention to positive/negative qualities that they associate with the vegetables.

4.6 Analysis of the Perceptual Data

4.6.1 Background

Multivariate methods of data analysis are used to aid the interpretation of significant findings, with generalised Procrustes analysis (GPA) and principal components analysis (PCA) commonly being applied to sensory data. While both these methods can be used interpret conventional profiling data, only GPA can be used with FCP or RGM data.

4.6.2 The Theoretical Background to Generalised Procrustes Analysis

Essentially, the data from the research presented in this thesis is free-choice data rather than the consensus data generated using conventional profiling (e.g. Quantitative Descriptive Analysis). Free-choice data cannot be averaged across all assessors and then

subjected to factor analysis or PCA (as with consensus data) as each assessor has generated different numbers of attributes, and many of these may differ between assessors (Dijksterhuis, 1996). GPA accounts for differences in the way in which assessors describe the same attribute, or differences in their perceptions of attributes (Arnold and Williams, 1986). This allows the assessors to use their own words to describe their perceptions; an advantage when dealing with young children who may have difficulty comprehending the meaning of consensus descriptors. GPA also accounts for discrepancies in the use of the scales, adjusting for different assessors using different ranges within the scale to score samples.

Each assessor produces an individual data matrix consisting of scores for each sample (rows) by attributes (columns). Geometrically, these matrices can be used to draw configurations for each assessor in a multi-dimensional space. With both free-choice and conventional profile data, due to differences between the assessors' scores (and the attributes used in FCP), the configurations for each assessor will differ. To produce a multi-dimensional plot that is easier to interpret (and showing agreement between the assessors), GPA involves three transformations:

- Translation
- Rotation/Reflection
- Isotropic scaling

4.6.2.1 The level-effect: Translation

The translation of the individual matrices brings them to a common centroid (conveniently taken as the origin). Translation in GPA is also known as the 'level-effect' as it accounts for the assessors using different parts of the scale when scoring. For example, one assessor might give the samples scores between 5 and 25 whilst another assessor scores them between 60 to 100 (on a 1 to 100 line-scale). Both assessors might perceive the samples in the same way, in terms of the magnitude of the difference between them, but they just use the scale differently (Dijksterhuis, 1996). Translation in

GPA has the same effect as removing the ‘assessor main effect’ in an analysis of variance (McEwan and Hallett, 1990; Dijksterhuis, 1996).

4.6.2.2 The interpretation-effect: Rotation/Reflection

Rotation and reflection are the transformations that adjust for the different assessors using different attributes to describe the same samples. This step is particularly important in FCP as it allows the experimenter to decide whether the attributes positioned near to each other are providing the same information about the samples (aiding the interpretation of the plot).

4.6.2.3 The range-effect: Isotropic scaling

Isotropic scaling corrects for the individual differences in scoring whereby assessors use different ranges of the scale (e.g. one assessors’ scores for the samples use a range of 20 scale points, whilst another assessors may use the entire scale, equivalent to 100 points). Their perceptions of the samples are not believed to rely on the range of scores used, so isotropic scaling controls for this undesirable effect. The configurations of each assessor are accordingly stretched or shrunk to match that of the ‘consensus’ configuration (McEwan and Hallett, 1990; Dijksterhuis, 1996). GPA in Senstools shows these as the assessor weights. If an assessor has a weight greater than 1, this indicates that they predominantly used the lower end of the scale (i.e. a small range) to score the samples and their configuration has been stretched accordingly. If the assessor weight is less than 1, the assessor has used a large range of scores and their configuration has duly been shrunk to fit the consensus configuration (McEwan and Hallett, 1990; Dijksterhuis, 1996).

The graphical output from GPA includes an assessor plot where each assessor’s matrix is matched as closely as possible with those of the other assessors. The Senstools program (Senstools for Windows v2.2, OPandP and Talcott, Utrecht, The Netherlands) bases the assessor plot on a PCA of the similarities in variance between the assessors. Assessors that are positioned close to each other perceive the samples in a similar way, while those

that are further away ('outliers') have a different perception of the samples compared to the other assessors (McEwan and Hallett, 1990). A consensus sample configuration is also plotted based on the Procrustes analysis (translation, rotation/reflection, and scaling) with samples positioned near to each other sharing commonly perceived characteristics. Sample residuals show the level of agreement between assessors with regard to their perception of the samples, while assessor residuals show how closely individuals agree with the consensus fit.

4.6.3 Use of Generalised Procrustes Analysis in the Interpretation of Perceptual Data

The score given to each sample for each construct was measured manually and entered into an SPSS spreadsheet (SPSS v.6.1, SPSS Inc., Chicago, 1993). This also contained coded information relating to the demographic variables also collected (i.e. age, gender, city, socio-economic status, frequency of vegetable consumption). Eliminating the demographic data and re-saving the file as an ASCII file allowed the data to be transported into Senstools for Windows v2.2 (OPandP and Talcott, Utrecht, The Netherlands) for analysis using GPA. Senstools uses the Gower (1975) 'classical' GPA, whereby when assessors have used different numbers of attributes from each other, the individual sets (assessor data set) are filled with columns of zeros to standardise them.

4.6.4 Discrepancies in the Assessors' Data Matrices

Missing values in individual's data matrices (where a child had missed a sample from a scale) were accounted for by averaging the score for all the other samples for that attribute and using this as a 'replacement' score. In some instances, assessors had given two different marks on the scale for the same sample, in which case the inter-distance between the two was calculated and used as the score.

4.7 Quantitative Analysis of the Impact of Demographic Variables on the Perceptions

4.7.1 Background

To assess the impact of demographic variables on the children's perceptions of the vegetables, a data reduction method which would afford easier interpretation of the multidimensional perceptual space was required. The perceptual data was free-choice rather than consensus data, and the demographic variables (e.g. age, gender, school, city, SES) had different measurement levels (some were nominal, some ordinal).

Principal components analysis by alternating least squares (PRINCALS) is a method suited to the data presented in this thesis because it can analyse variables that have different measurement levels – data that are nominal, ordinal, interval or ratio and the variables may be continuous or discrete (SPSS Inc., 1994a).

4.7.2 The Theoretical Background to Principal Components Analysis by Alternating Least Squares

PRINCALS (a.k.a non-linear, or non-metric principal components analysis) is an optimal scaling technique that analyses a set of variables to elicit the main dimensions of variance, as does classical PCA. A new, smaller data set of uncorrelated variables is generated, losing as little information as possible from the variables (i.e. in this instance: age, gender, city, SES, school and frequency of vegetable consumption). It should be noted that PRINCALS cannot be used to confirm a hypotheses; rather it is an exploratory tool.

PRINCALS uses an alternating least squares optimal scaling technique. Alternating least squares optimal scaling transforms qualitative data (i.e. nominal and ordinal data) to interval data (the initialisation and updating of object scores stages of the PRINCALS method). The method alternates between model estimation and optimal scaling phases by

a process of iteration. During the model estimation phase the data transformations remain constant while least squares estimates of model parameters are obtained. During the optimal scaling phase the model parameters are held constant and the function is optimised by obtaining least squares estimates of the transformation. The PRINCALS method (as with all alternating least squares optimal scaling methods) alternates between the model estimation and the optimal scaling phases until it reaches convergence.

In simple terms, the method begins with a data matrix with subjects as rows and the nominal variables (e.g. age, gender, SES) as columns. To obtain the solution, the method alternately locates the row points in the centroids of the categories belonging to them, and maps the categories in the centroids of the row points to which they belong. On reaching convergence, the solution consists of a set of coordinates for the rows (object scores) and a set of coordinates for the categories (category quantifications). The category quantifications are transformations of the original (nominal) category values (SPSS Inc., 1994a).

4.7.3 Homogeneity Analysis by Alternating Least Squares

Another method which can be used to analyse categorical data with different measurement levels is homogeneity analysis by alternating least squares (HOMALS). While PRINCALS is a method for non-linear PCA, HOMALS is a non-linear correspondence analysis technique which can be used when there are more than two variables; hence it is also known as multiple correspondence analysis. As with PRINCALS, HOMALS starts with a data matrix of subjects (rows) by nominal variables. HOMALS tries to position the row points from the data matrix (usually the subjects, however HOMALS calls these 'objects') so that they optimally coincide with the points of those categories that belong to them. Simultaneously, the category points need to optimally coincide with the row points to which they belong. Whilst these two conditions will not be perfectly satisfied, the iteration process will continue until the convergence test indicates that an optimal solution has been found.

Both PRINCALS and HOMALS can handle missing data in the input data matrix.

4.7.4. Principal Components Analysis

Principal components analysis (PCA) is a data reduction method whereby sensory attributes can be reduced to a smaller set of attributes (components) whilst retaining as much information from the original attributes as possible, and revealing relationships among groups of attributes, and between objects (e.g. samples). PCA reduces the dimensionality by extracting the linear combinations of the original attributes to produce the variables ('principal components') accounting for the majority of the variance within the original data (Piggott and Sharman, 1986; Gacula 1997). The components are a linear combination of the original attributes which remain uncorrelated with subsequent components. When two or more attributes are strongly correlated, the majority of the variance can be explained by drawing a new axis through the centre of these observations, minimising the sum of the squared residual distances. Any remaining variance within the data can be explained by constructing a second axis (principal component 2) orthogonal (i.e. statistically independent) to the first axis (Piggott and Sharman, 1986).

The first principal component (PC1) accounts for the most variance in the data, the second principal component (PC2), uncorrelated with PC1, accounts for the next largest amount of variance and so forth in diminishing order of variance. Each principal component is made up of a number of attributes. When products are similar in sensory character, PCA produces a plot with samples clustered around the origin, whereas when the samples are different the samples scatter on the plot. PCA allows the analyst to view relationships between products and attributes more clearly.

4.8 Analysis of the Hedonic Data

4.8.1 Background

Univariate analysis of the hedonic data from the score sheets using a method such as analysis of variance would have identified any significant differences in the children's preferences for the vegetables. However this method analyses the mean hedonic scores for each sample and does not illustrate the clustering of assessors who share similar preferences for particular samples. Preference mapping does not average the individual assessors' differences in their hedonic scoring, and produces a multidimensional representation (Greenhoff and MacFie, 1994) which is easy to interpret.

There are two types of preference mapping, internal analysis (commonly abbreviated to MDPREF) and external analysis (commonly abbreviated to Prefmap). Internal preference mapping produces a multidimensional plot of the samples based solely on the preference data, whilst external analysis correlates the samples' acceptability to either instrumental or sensory data in a multidimensional form (Greenhoff and MacFie, 1994).

4.8.2 The Theoretical Background to Internal Preference Mapping

Internal preference mapping is a variant of PCA, with the acceptance data replacing the attribute scores of PCA in a product (rows) x acceptance scores (columns) data matrix. Whereas PCA identifies the main source of variation in the data and extracts this as PCA Factor 1, internal preference mapping does the same within the preference data, extracting the major variation as preference dimension 1 (Greenhoff and MacFie, 1994). The second preference dimension is orthogonal to the first, and so on until all the variance in the data has been explained. Sample co-ordinates are produced for each preference dimension for the assessors whose hedonic scores correlate with the dimension. It is from these that the multidimensional preference maps are constructed.

Internal preference mapping requires all assessors to have provided scores for all the samples (a minimum of 6 samples). The individual preference configurations are then

translated to zero (the common centroid as in the first stage of GPA). The internal analysis takes place after this step, as is clearly illustrated by Greenhoff and MacFie (1994, p 147).

4.8.3 The Use of Internal Preference Mapping in the Interpretation of the Hedonic Data

In the case of the main study, the assessors' hedonic scores were analysed using internal preference mapping as no additional 'external' data (i.e. from conventional profiling or instrumental analysis) was available. Senpak v2 (RSSL, Reading, UK) was employed to conduct the internal preference mapping.

4.8.4 Discrepancies in the Assessors' Hedonic Data Matrices

In instances where assessors had missing values in their data sets (i.e. had forgotten to score one or more of the vegetables for liking) mean substitution was employed using the subject mean (after Hedderley and Wakeling, 1995).

4.9 Development of the Questionnaire

4.9.1 Background

Having conducted the pilot study in Cambridgeshire, it became apparent that some of the factors influencing children's perceptions of vegetables might be best explored (and quantified) using a questionnaire. The pilot study suggested that the children's exposure to/experience with vegetables influenced their overall perceptions and their knowledge of the samples. Having information on the children's knowledge of the sample vegetables would be informative when examining the perceptual data. It was also decided that a measure of the children's current weekly vegetable consumption would be useful for correlating with their preferences and perceptions. Consumption data would additionally allow the group to be divided into low vegetable consumers and high vegetable consumers to group the assessors when analysing the perceptual data for significant

differences.

Another important issue to be explored in the questionnaire was the children's familiarity with the samples and their degree of liking (with reasons) for these vegetables. Who chose the vegetables that the children ate at home was of interest, providing a measure of the children's involvement in their consumption. Another question aimed to gauge the importance of school meals to the children's total vegetable consumption. School meals were (from the literature) anticipated to be an especially important source of vegetables for the low socio-economic status children.

The final question in the pilot questionnaire asked the children to indicate how suitable all the possible combinations of the pairs of vegetables were for eating together in the same meal using a 5-point scale (from 'very suitable' to 'very unsuitable'). The idea for this came from research conducted by Drewnowski (1996) whereby 150 adults' perceptions of 20 vegetables were investigated, and hierarchical cluster analysis identified the most and the least compatible clusters of vegetables. It was thought that similar information from the child assessors in this study would provide an indication of the vegetables that the children found suitable for serving together, and those that they did not like the idea of eating together. This was thought to be of interest to the school meals providers.

4.9.2 Piloting the Questionnaire

A questionnaire was drafted to address these issues and piloted among 40 children aged between 7 years 0 months and 9 years 10 months (average age 9 years 0 months) in January 1997. Questionnaires (see Appendix 2) were distributed among the eligible children of staff and students at Queen Margaret College, as well as a primary four class from a nearby school. It was made clear that the children were to complete the questionnaire, although the parents/teacher could help them to read it, or if there were comprehension difficulties. There was a section for the children/parent/teacher to write their comments about the ease of completion, and any hints for improving the

questionnaire.

Even the youngest child involved in the questionnaire pilot study was able to successfully complete the questionnaire. Comments from the children/parent/teacher suggested that many of the children ate additional vegetables other than those the questionnaire asked about (the samples from the RGM study). Also, the question asking the children to show how suitable the pairs of vegetables were for eating together was time-consuming and could be mis-interpreted. Some children were identifying the pairs as unsuitable if they did not like one of the vegetables, whereas others answered the question by remembering pairs of vegetables that their parent or the school served together.

4.9.3 Questionnaire for the Main Study

As a result of the feed-back from the pilot study it was decided to make some changes to the questionnaire before the main study. The perceptual data from the pilot RGM had made mention of meals which the assessors thought particular vegetables could be served with. This 'suitability' aspect was of interest, and so nine common foods/meals were selected using Anderson *et al.* (1994b) as a reference. The foods to be scored were: chicken, sausages or bacon, burgers, red meat (pork, ham, lamb, beef), soups, stews, pies, fish, and a cooked breakfast. A grid was constructed and the children would need to score how nice they thought each vegetable would be to eat with the nine meals. This also covered the issue of pairs of vegetables that went well together, as analysis of the grid results could reveal vegetables that frequently clustered together. Therefore this grid showing compatibility with common meals replaced the final question from the pilot questionnaire.

During the main study, 88 children returned the questionnaire (see Appendix 3) out of a total of 94 children. The data from the questionnaires were input into SPSS v 7.5 for subsequent analysis. The analysis and a discussion of the results are presented in Chapter Nine.

CHAPTER FIVE: AN EVALUATION OF THE USE OF REPERTORY GRID METHOD TO ELICIT PERCEPTUAL DATA FROM PRIMARY SCHOOL CHILDREN: THE PILOT STUDY:

5.1 Introduction

An initial study was conducted to assess the use of Kelly's (1955) repertory grid method (RGM) with child assessors to elicit perceptual data related to foods (vegetables in this instance). Another of the aims of this study was to obtain information about children's perceptions of vegetables, particularly textural perceptions, to show if this attribute could be found to influence the children's acceptance/rejection of the vegetables studied.

Texture, the 'forgotten food attribute', is more involved in influencing food acceptance and nutrition than perhaps we initially realise (Szczesniak, 1987). Szczesniak suggested that the food textures influence consumers' decision to accept/reject a food, while also affecting digestion and nutrient absorption, and oral health and dentition (Szczesniak, 1987). Although the literature suggests texture to be important in children's rejection/acceptance of vegetables, there was no evidence (Food Science and Technology Abstracts 1969-1996) to suggest any further research into this area since the 1970's.

Whilst simultaneously studying the importance of texture to children's acceptance of vegetables, this study also aimed to assess the suitability of using RGM to elicit personal constructs which could then be scored to provide quantitative data on children's perceptions of the sample vegetables. A survey of the literature (Food Science and Technology Abstracts 1969-1996) suggested that using this approach to examine children's food perceptions was a novel application of the repertory grid technique.

The use of personal constructs when scoring samples has an advantage over a fixed descriptive list (as used in Quantitative Descriptive Analysis) in that it allows assessors to use their own vocabulary, excluding the need for them to 'learn' exactly what sensation is being described by each term (attribute). For this reason, RGM was deemed to be a method potentially well suited for use with child assessors.

5.2 Experimental Procedure

The primary school chosen to provide assessors for this study was a school in a village to the south of Cambridge with an approximate population of 5000 (1994 mid-year population estimate). As this was a pilot study to assess the use of the methodology for the main study, it was not necessary to use Scottish children, and an opportunity had arisen for the author to conduct the study at a primary school near to her parent's home. The school has a varied catchment area, encompassing rural fenland hamlets and an army barracks, as well as the population of the village *per se*. All socio-economic backgrounds are represented at the school, although the majority (61%) of households in the catchment area are of social classes I (professional) to IIIM (manual, skilled occupations), and predominantly (99.2 %) Caucasian (1991 Census).

5.2.1 Assessors

In total, 23 children participated in the study. They were aged between eight and eleven years old (mean age 10 years 3 months). There were 12 males and 11 females, with assessors chosen randomly from the school roll whilst ensuring approximately equal numbers of the sexes.

5.2.2 Selection of the Vegetables

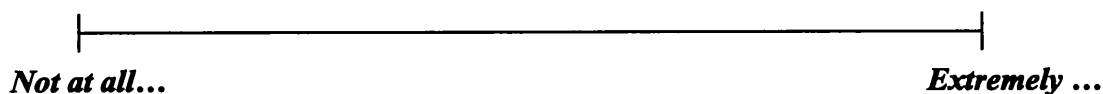
A maximum of eight samples are recommended for a RGM study using children (Salmon, 1976). More detail is given on the selection of the samples used for the pilot study in Chapter 4 (p.94-96). The samples were cooked carrots, raw carrots, sweet corn, peas, cucumber, celery, capsicum (peppers), and mushrooms.

5.2.3 Repertory Grid Method

Assessors were interviewed individually in the first instance. RGM was employed using laminated, labelled photographs of the eight vegetables as described in Chapter 4. No taste-testing was conducted. At the end of the RGM session, assessors were then asked how many times a week they ate any vegetables (not limited to the eight vegetables used for the RGM interview).

5.2.4 Scoring of Constructs

Three days after the initial interview, assessors scored all eight vegetables with respect to their individual perceived sensory attributes and suitability for use in certain eating situations as elicited during the RGM session. 15cm linear scales were used, anchored by the terms “not at all...” and “extremely...”. A scale to indicate degree of liking for each vegetable was also included in all score-sheets.



The scoring of the samples has been covered in more detail in Chapter Four.

5.2.5 Treatment of the Data

Data from the linear scales were analysed by GPA using Senstools for Windows v2.0 (OPandP and Talcott, Utrecht, The Netherlands). By analysing ensuing data using Generalised Procrustes Analysis (GPA) (Gower, 1975), variation due to assessors using different terms to describe the same stimuli and/or differing in their use of scales when scoring can be eliminated (Arnold and Williams, 1986). The hedonic data were subjected to an internal preference analysis using Senpak v2.0 (RSSL, Reading, UK).

5.3 Results

5.3.1 Perceptions of the Vegetables

Assessors generated between 5-13 attributes (mean of 9). GPA produced three explainable dimensions pertaining to sensory properties, situational usages, and perceived need for cooking associated with the vegetables. During the elicitation phase, nutritional properties such as ‘good for you’, ‘healthy’, ‘full of vitamins’ and ‘helps you see in the dark’ were often mentioned (eleven assessors; nine female, two male). However, none of these properties strongly correlated with the first three dimensions of the sample space, therefore were not particularly influencing the children’s perceptions of the vegetables assessed. Figures 5.1 to 5.2 show the plots of the first three dimensions of the sample space, accounting for 42 %, 19 % and 12 % of the total variance respectively. Assessors’ descriptors having correlation coefficients of about 0.70 and above with the first three dimensions can be seen in Table 5.1.

Table 5.1: Children’s attributes having correlation coefficients of ≥ 0.70 for Dimensions 1-3.

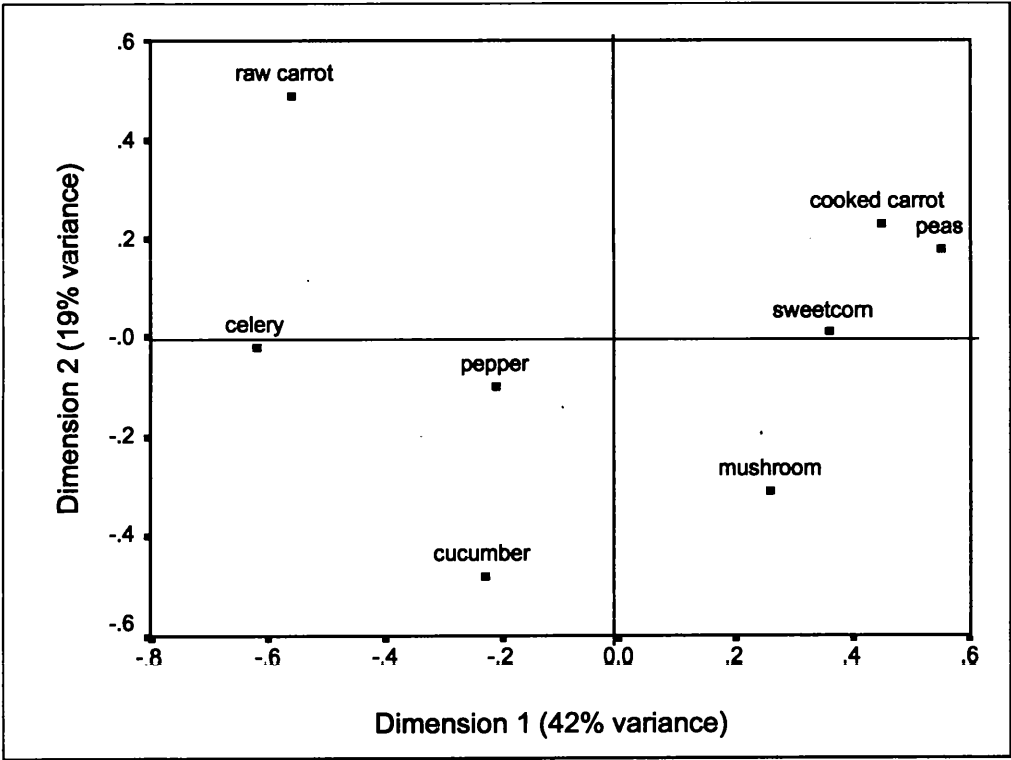
Dimension 1 (42%)	Dimension 2 (19%)	Dimension 3 (12%)
<i>Perceived Need for Cooking</i>	<i>Specific Meal Occasions</i>	<i>Specific Meal Occasions</i>
Hot (temperature) (+2)	Sunday* (+1)	Raw (+2)
Cooked (+1)	Raw (+1)	In salad (+2)
Eat cold (-2)	In salad (-5)	In sandwiches (+1)
	In sandwiches (-1)	On its own (+1)
<i>Specific Meal Occasions</i>		Stir-fry (-1)
Sunday* (+7)		
In/with a curry (+2)		
With a cooked meal (+1)	<i>Sensory Properties</i>	
With meat (+1)	<u>Texture</u>	<i>Sensory Properties</i>
Salad (-5)	Hard (+2)	<u>Texture</u>
In dips (-3)	Crunchy (+1)	Hard (-1)
	Chewy (+1)	
<i>Sensory Properties</i>	Juicy (-3)	<u>Flavour</u>
<u>Texture</u>	Soft (-2)	Tasty (-1)
Soft (+7)	Watery (-1)	Spicy (-1)
Mushy (+6)		
Chewy (+2)	<u>Flavour</u>	
Soggy (+2)	Sweet (+1)	<i>Other</i>
Juicy (+1)	Tasty (+1)	Like (+5)
Crushable (+1)	Sweet (-1)	
Hard (-13)	Spicy (-1)	
Crunchy (-6)		
Refreshing (-1)	<i>Other</i>	
Crispy (-1)	Like (+2)	
Veins (-1)	Like (-1)	
Smooth (-1)	Cleans your teeth (+1)	
Juicy (-1)		
<u>Flavour</u>		
Strong taste (-1)		
<i>Other</i>		
Like (+1)		
Like (-3)		
Cleans your teeth (-1)		

Notes

Figures in brackets indicate the number of assessors significantly (≥ 0.7) rating the attribute as important, whilst the sign relates to the direction of this correlation. Sunday encompasses the attributes: “on a Sunday”, “with Sunday lunch/dinner”, and “with a roast”.

Dimension 1 (Figure 5.1) relates to the perceived need for cooking (significantly cited by n=6 assessors), the texture of the vegetables (n=20), and the specific meal occasions (n=15) for which the vegetables are seen to be suitable. Cooked carrots and peas, (and to a lesser degree sweetcorn), were strongly correlated with the positive axis of this dimension. The children perceived these three vegetables to be eaten hot, with meat or within the context of another cooked meal (e.g. a vegetarian dish). The most frequently cited usage for vegetables on Dimension 1 was as part of the main Sunday meal (correlating with the positive axis of Dimension 1), as mentioned by seven assessors. Cooked carrots, peas and sweetcorn therefore were the vegetables the children commonly associated with eating on Sundays with the roast dinner.

Figure 5.1: Dimension 1 (42%) and Dimension 2 (19%) of the sample consensus space.



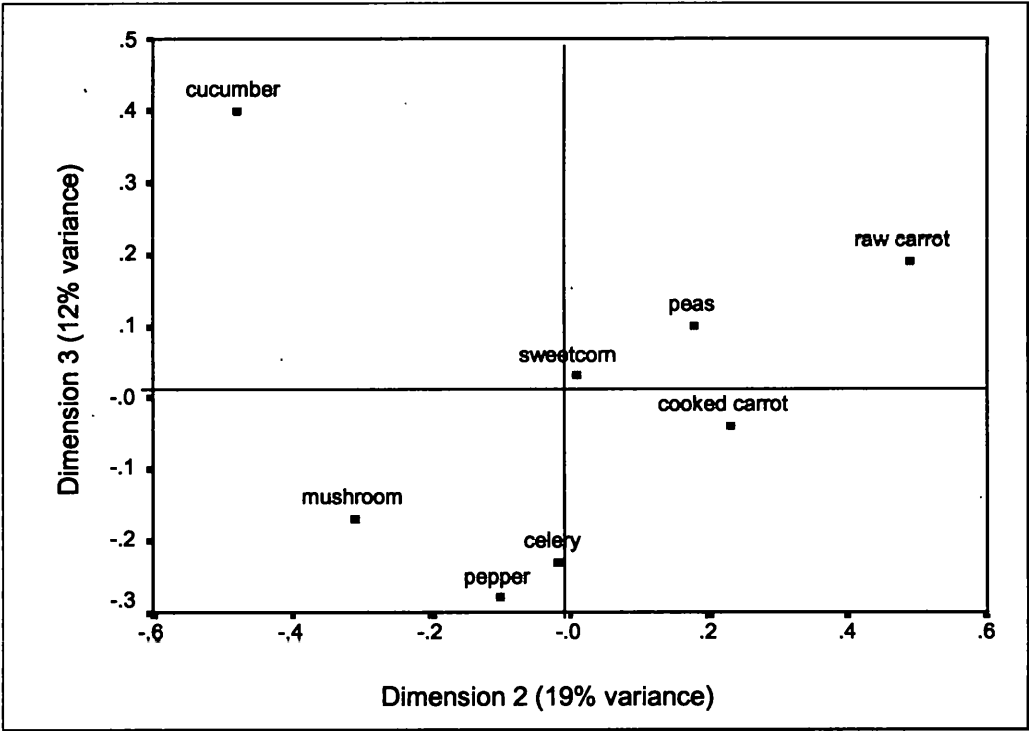
Vegetables correlating with the positive end of the first dimension were significantly described as having soft, mushy, soggy or chewy textures by fourteen assessors. Not surprisingly perhaps, given the negative connotations associated with terms such as “soggy” and “mushy”, only one assessor liked the vegetables associated with the positive end of Dimension 1. Conversely, at the negative end of the first dimension, the vegetables (raw carrot, celery, pepper, and cucumber) were perceived to be preferable to the cooked samples by three assessors. The children perceived this group of vegetables to be eaten in salads (n=5), to be crunchy (n=6) and hard (n=14). Another usage for these vegetables was as *crudités* (n=3) for dipping in sauces along with crisps and bread-sticks, influenced by the wide availability of ready-made dips in supermarkets. ‘Dipping’ was described during the elicitation process by these three assessors as a treat and appeared to be a pleasant and trendy way to consume raw vegetables.

As with the first dimension, specific meal usages (n=6) and textural properties (n=9) divide the samples in Dimension 2, although flavour properties are additionally cited (n=4). Celery, peppers, mushrooms and cucumber at the negative end of the second dimension are defined by their juicy/watery properties and suitability for salads. Mushrooms were perceived to require cooking, yet were not grouped with the other ‘cooked’ vegetables (cooked carrots, peas and sweetcorn). It is interesting to note the isolation of mushrooms from the other cooked vegetables (Figures. 5.1 and 5.2). This may be explained to some degree by the non-significant attributes mentioned during the elicitation process. It appears that assessors found mushrooms acceptable when served as an integral part of a meal (e.g. in a chilli-con-carne, or in stir-fries), but not as a vegetable to be served as a meat accompaniment.

The vegetables are separated along Dimension 3 (Figure 5.2) with celery, peppers and mushrooms at the negative end of this dimension, and cucumber, raw carrot, (and to a lesser extent, peas and sweetcorn) at the positive end. From studying the constructs in Table 5.1, the positive axis of Dimension 3 can be shown to be describing those vegetables which the children felt could be eaten raw and in salads. It was found that the

hedonic scores of five assessors (all from the upper end of the age range) correlated strongly with vegetables having these properties associated with the positive end of this dimension.

Figure 5.2: Dimension 2 (19%) and Dimension 3 (12%) of the sample consensus space.



For Dimensions 1 and 2 of the consensus space (Figure 5.1), mushrooms and raw carrots were shown to be outliers. Examining the assessors responses showed that mushrooms did not fit into the Sunday cooked meal occasion, nor were they associated with the crunchy, hard-textured vegetables perceived to be used in salads. Attributes pertaining to dental hygiene and “*eating as a snack at school*” were peculiar to raw carrots, thus explaining their segregation from the rest of the samples for the first two dimensions. Cucumber was an outlier on the second and third dimensions of the consensus space (Figure 5.2) due to its particular juiciness, suitability for eating on its own, and its unique usage as a sandwich filling.

5.3.2 Self Reported Typical Weekly Vegetable Consumption

It was found that all 23 assessors randomly chosen to participate in this study ate some vegetables at least once a week. Thirty percent ($n=7$) of the respondents ate vegetables every day, 35% ($n=8$) ate them “a couple of times” a week, and 35% ($n=8$) claimed to eat them only once a week. All of the eight assessors who only ate vegetables once a week consumed them within the context of the main meal on a Sunday.

5.3.3 Preference Scores for Sample Vegetables

A hedonic scale was included in each of the children’s score-sheets, anchored “not like at all” and “like extremely” at either end. The assessors were instructed to rate their preferences for the eight vegetables using this scale; the author having first demonstrated this using fruits as examples so as not to bias the results.

The preference scores were analysed using Senpak v 2.0 (RSSL, Reading, UK) to construct the internal preference map (Figure 5.3). Assessor 23 was excluded from the analysis, as this child had not discriminated between the samples in terms of their preference. The first three preference dimensions account for 64% of the total variance. Friedman two-way analysis of variance showed that the samples were significantly different with regard to the children’s preferences ($p \leq 0.05$), with mean hedonic scores ranging between 4.88 to 9.90 (Table 5.2). Cucumber and raw carrots were the most liked vegetables, although the very large standard deviations shown in Table 5.2 demonstrate the wide discrepancies between individual’s preference scores. Mushrooms, peppers and celery all received average scores in the dislike portion of the scale and were the least popular samples.

Figure 5.3: Internal analysis on hedonic scores of assessors who are fitted on preference dimensions 1 and 2.

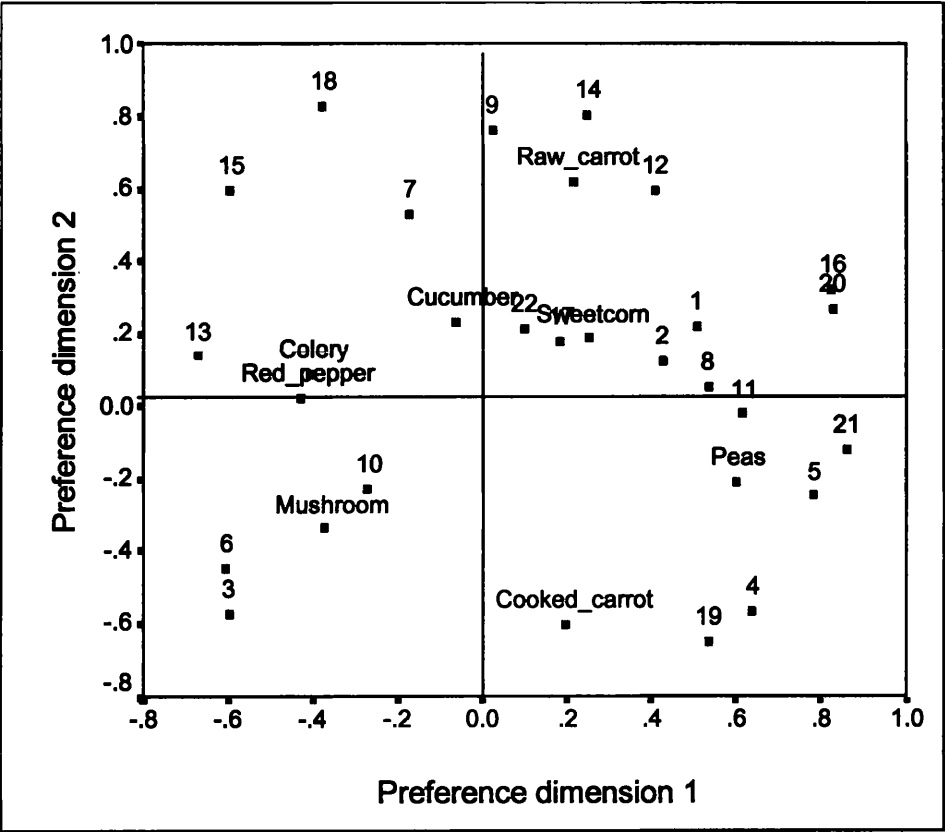


Table 5.2: Mean hedonic scores for the sample vegetables

Vegetable	Mean rank for hedonic score (p=0.028)	Mean hedonic score* (scale 0 to 15)
Cucumber	5.36	9.92 (4.96)
Raw carrot	5.45	9.90 (5.04)
Pea	4.73	8.16 (5.74)
Sweetcorn	4.61	7.84 (5.85)
Cooked carrot	4.68	7.83 (4.99)
Celery	4.11	7.02 (5.01)
Mushroom	3.89	5.86 (5.02)
Pepper	3.16	4.88 (5.11)

** Note: Standard deviations are given in brackets. 1=not like at all; 15 = like extremely.*

Examining the GPA sample plots (Figures 5.1 to 5.2) partially helps to understand the children's preference results. The preferred vegetables (cucumber and raw carrots) are both eaten raw and in salads (Figure 5.2), and therefore it can be inferred that crunchiness is also an attractive property of vegetables. However, in Figure 5.1 it can be seen that peppers and celery are also eaten raw and in salads yet these vegetables are disliked.

One explanation for this discrepancy is that the usages of the vegetables do not influence preference, but the texture/flavour does. While crunchy (raw) vegetables are liked, it is perhaps the flavour that drives preference and the taste of peppers may be disliked.

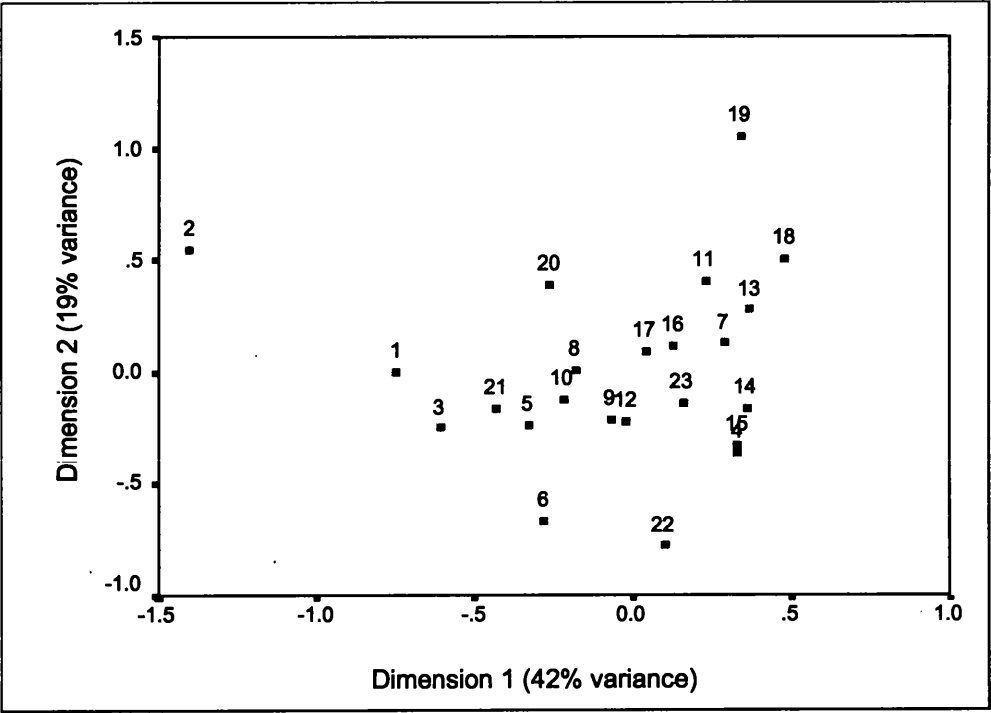
Celery was described in the initial interviews as being "stringy" on numerous occasions, and it is probable that this influenced the children's rejection of this vegetable.

Mushrooms were perceived to be unlike the other vegetables in that they were suited to eating mixed throughout a dish, but not as a cooked accompaniment to meat. It is not clear from the RGM/GPA results what the children particularly disliked about mushrooms.

5.3.4 Suitability of Repertory Grid Method for use with Child Assessors

The assessor plot (Figure 5.4) shows the children to be discriminating in a similar way as a group, with the exception of the outlying assessor 2. This assessor had particularly low variance scores on Dimensions 1 and 3 of the consensus space, indicating that he was discriminating between the samples using different criteria from the rest of the group. Overall, RGM was shown to give meaningful results.

Figure 5.4: Assessor plot derived from GPA of free-choice profile data



The use of RGM to evaluate children’s perceptions of vegetables possibly has many advantages over other methods such as focus groups, or conventional sensory profiling techniques. The individual interview procedure effectively eliminates the problems of group dynamics associated with focus groups (e.g. non-participation, dominance by members of the group) and every child was able to elicit some ‘useful’ constructs. It was found to be helpful if a few minutes were spent initially putting the younger age group

participants at ease by chatting to them about general topics before commencing the RGM process. An advantage of using photographs of the samples when working with child assessors is that it avoids ethical issues associated with the actual consumption of samples as with conventional sensory profiling.

There are, of course, some disadvantages to using RGM rather than sensory profiling methods with children to elicit perceptions about products. One disadvantage of such a relatively unstructured interview process was that some children were so enthusiastic that they frequently had to be asked to be more subject specific as they were digressing. Also, as each child is interviewed individually, and interviews can be lengthy depending on the amount of information required by the researcher, the method can be disruptive for both the teacher and the pupils. Scoring of the attributes on the scales can be a laborious task if the subject cited many attributes of interest. Retaining the child's interest in the task could be a potential challenge for the researcher (although problems were not encountered during this study), but one which could possibly be alleviated by having more than one session for scoring the attributes.

A limitation of RGM is that it relies on the children having previous experience with/ knowledge of the samples to be able to describe similarities and differences between pairs of samples. This restricts the sample set from which you can choose samples to assess. With sensory profiling using actual foods to taste, assessors are able to make on-the-spot judgements of novel samples if presented at a testing session.

5.4 Discussion

It is evident from the correlations between degree of liking and vegetables displaying crunchy, hard textures, and absence of liking for those with soft, mushy textures, that the preparation and cooking of vegetables is critical in influencing children's willingness to eat them. In 1972, Szczesniak had deduced from consumer interviews with the mothers of young children (infants to 12 year olds) that "*textures (of vegetables) are extremely*

important...and raw vegetables are preferred to cooked ones". The results presented here support these statements, revealing that little appears to have changed in respect of children's perceptions of vegetable textures over the past 25 years.

When Cathro *et al.* (1995) interviewed their subjects, they learnt that the low vegetable consumers typically had a limited repertoire of vegetables, and prepared these few by boiling them for 30 minutes. Considering the assessors' negative perceptions of 'soggy' and 'mushy' textures in this current study, if the parents of low vegetable consumers are serving such unappealing vegetables, it is unsurprising if their offspring are unwilling to consume them.

Cathro *et al.* also reported that when recipes were given to the low vegetable consumers, the most popular were the stir-fry, curry and pasta bake which *"hide the 'vegetable' element with a strong 'ethnic' sauce"*. Proper stir-frying ensures that the vegetables remain crispy and firm so this method of cooking should be popular with the children. Szczesniak and Kahn (1971) suggested that consumer awareness of food texture is overshadowed by flavour at the conscious level, but that if a food is bland, or crisp/crunchy, textural awareness increases. So whilst it could be the texture of the vegetables in a stir-fry which is appealing to the children, the strong flavour (also associated with other foods such as curries) which conceals the flavour of the vegetables could be the tempting factor. This can be illustrated by a quotes from two of the assessors during the elicitation phase *"Some vegetables I don't like are in stir-fry and they're much nicer in stir-fry because they've got sauce on them so you can't taste them"* (female, aged 9 years); *"I prefer vegetables all mixed up with food because with things like lasagne you get like pasta or a sauce"* (female, aged 9 years).

It became apparent during this study that the children had definite ideas about which vegetables were appropriate for particular usages. The importance of Sunday dinner in terms of vegetable consumption is apparent as it was the only time during the week that 35% (n=8) of the children ate any vegetables whatsoever. Whilst carrots (both raw and

cooked), peas and sweetcorn were the vegetables associated with the Sunday meal, it should be noted that only eight vegetables were examined during the study which obviously limited the children's choices. Despite this, these three common vegetables were mentioned frequently in conjunction with the Sunday roast (14 citations). These results back-up the findings from a recent study (Cathro *et al.*, 1995) whereby both high vegetable consumers and low vegetable consumers chose vegetables on the basis of which meat dish they were serving, and had fixed ideas about which vegetables went with which meal. Obviously, this would limit the children's exposure to certain types of vegetables, and reinforce the importance of 'appropriateness' of a vegetable to a particular eating situation.

One possible reason for the reported low consumption of vegetables amongst children is the prevalence of snacking as a favoured eating pattern among adolescents (Anderson *et al.*, 1993; Spyckerelle *et al.*, 1992) and younger primary school aged children (Ruxton *et al.*, 1996; Livingston, 1991; Magarey *et al.*, 1987). The majority of the subjects in these studies snacked on high sugar/high fat foods, with just 5% of Ruxton's subjects reporting that they snacked on raw vegetables. Anderson *et al.* (1994a) found that over one-third of the adolescents in their study 'never' or 'less than once a week' ate root vegetables or cooked green vegetables, with the authors explaining these low consumption rates by the probability that snacking does not facilitate the consumption of vegetables. Nevertheless, it is encouraging that 40% (n=9) of the children from this pilot study reported snacking on raw vegetables, especially carrots. These were reported as being consumed at school during break-time by two assessors, whilst a further six said they ate raw carrots 'on their own' or 'with dips'. All of these usages could be construed as snacking occasions.

Overall, RGM was found to be a method well suited to child assessors for obtaining information relating to their perceptions (sensory and more general) of foods. One major advantage of the RGM method used here is that, compared to conventional sensory profiling studies, it was inexpensive to conduct the research. Since no 'real' food samples are used problems associated with the storage of samples (e.g. shelf-life, storage space),

and transportation to study are eliminated. Additionally, samples need only be purchased once for photographic purposes, and individual samples are not required for each assessor. This makes the method very economical when large numbers of assessors are required. Preparation prior to data collection is minimal; another major advantage over conventional tasting panel sessions which require time-consuming preparation to ensure the products are identical for each assessor. By prompting during the RGM stage, sensory perceptions about products with which the assessor has had previous exposure to can be elicited, which when combined with hedonic information can provide useful information about 'ideal' products.

5.5 Conclusions

The relatively small number of assessors ($n=23$) and samples ($n=8$), whilst being sufficient in numbers for the method to yield significant results, do limit the wider meaning of the results from the study. The effects of factors such as SES, age, gender, or geography (the National Food Survey (MAFF, 1996) reveals striking contrasts in vegetable consumption between different areas of the UK), cannot be taken into account, and no generalisations about this age groups' perceptions of vegetables can be made.

It can, however be stated that RGM was found to be a method well-suited to the abilities of children aged 8 years and over as a means to generating descriptors. The ensuing perceptual data showed that these children separated this set of vegetables according to three main criteria:

1. Sensory properties e.g. texture, flavour.
2. Situational usages e.g. Sunday meal, salads, snacking at school.
3. Perceived need for cooking e.g. eating raw, eat with cooked meal, eat hot/cold.

Textural properties were found to influence preferences, although more often were used to determine aversions to vegetables prepared in a certain way. This kind of perceptual

information has potential applications for manufacturers wishing to develop new vegetable-based products aimed at young consumers. Health promoters would also do well to take notice of children's perceptions of vegetables, maximising the positive attributes when devising healthy eating campaigns to appeal to this important age group.

Expanding the samples studied by running two or more RGM sessions with assessors would allow perceptions about vegetables as a generic group to be reported, rather than those pertaining to eight particular vegetables. Further work is now required to examine a larger group of children's perceptions of vegetables, whilst also accounting for the demographic factors which could explain the reported differences in consumption among different groups of UK consumers (MAFF, 1996).

Note

This chapter is based on a previously published paper (see Appendix 4 for a copy):

Baxter, I.A., Jack, F.R. and Schröder, M.J.A. (1998). The use of repertory grid method to elicit perceptual data from primary school children. *Food Quality and Preference*, 9 (1/2), 73-80.

CHAPTER SIX: THE INFLUENCE OF CONTEXTUAL FACTORS ON PERCEPTIONS OF AND PREFERENCES FOR VEGETABLES AMONG EDINBURGH PRIMARY SCHOOL CHILDREN FROM SOCIALLY DISPARATE BACKGROUNDS.

6.1 Introduction

Socio-economic status has previously been linked to vegetable intake, whereby those of higher socio-economic status consume more vegetables than those of lower socio-economic status (MAFF, 1996; SOHHD, 1993; Anderson *et al.*, 1994b; Shepherd *et al.*, 1996). However, there are also low consumption rates among children in households where money is not a barrier (MAFF, 1996) suggesting that there may be perceptual factors which inhibit children's consumption of vegetables; irrespective of socio-economic status. Given that continued exposure to foods has been demonstrated to shape children's preferences (Birch *et al.*, 1987; Birch *et al.*, 1982), children from low socio-economic status families, who typically have lower vegetable consumption than their higher socio-economic status peers, might be expected to have different perceptions of vegetables.

This chapter assesses the influence of socio-economic status, age, gender and self-reported frequency of vegetable consumption upon the vegetable perceptions and preferences of forty-nine Edinburgh school children.

6.2 Materials and Methods

6.2.1 Samples

The eight vegetables used in this study were: baked beans, tomatoes, carrots, cauliflower, turnip, cabbage, sweetcorn and peas. See Chapter 4 (Methodology) for details.

6.2.2 Assessors

The assessors were 49 children aged between 8-10 years old from Primary 4 classes of two schools in Edinburgh. The schools were in socially disparate areas of the city, represented by the deprivation category (DEPCAT) scores (Carstairs and Morris, 1991) which are assigned to the postcode sector of the school and surrounding housing. None of the pupils at the 'advantaged' school (DEPCAT 1 area) were entitled to free school meals, while all those at the 'disadvantaged' school (DEPCAT 7 area) received them. This chapter discusses the data from 24 assessors at the advantaged school (12 male, 12 female), and 25 assessors (9 male, 16 female) at the disadvantaged school.

6.3 Procedure

6.3.1 Repertory Grid Method to Elicit Constructs

Kelly's (1955) repertory grid method (RGM) was used as an interview technique to obtain information pertaining to the assessors' perceptions of the vegetables. The use of RGM to elicit perceptual data relating to food choice with this age group had previously been validated (Baxter *et al.*, 1998). For further information on the RGM procedure as used, refer to Chapter 4.

6.3.2 Scoring of Personal Constructs

Assessors were given personalised score sheets containing 10cm linear scales representing each of their constructs. The terms "not at all..." and "extremely..."

anchored the scales. Examples of typical constructs were used with the assessors to demonstrate how to complete the scoring, with fruits as the samples, so as not to influence the assessors. Once the assessor had grasped the concept, they scored all eight vegetables for each of their constructs. Additionally, each score sheet included a hedonic scale to measure the assessors' liking for each of the vegetables.

Data from the score sheets were analysed by Generalised Procrustes Analysis (GPA) using Senstools for Windows v2.2 (OPandP and Talcott, Utrecht, The Netherlands). The hedonic scores were analysed by Senpak v2.0 (RSSL, Reading, UK) which was used to produce an internal preference map.

6.4 Results

6.4.1 Results of Generalised Procrustes Analysis

Combined, the assessors generated between 6-23 constructs (mean of 15). The disadvantaged assessors produced between 11-23 constructs (mean 17) and the advantaged assessors produced between 6-23 constructs (mean 15). GPA produced 5 dimensions that explained the perceived differences between the vegetables, accounting for 88% of the total variance. Assessors' descriptors having an absolute correlation of ≥ 0.65 with the first five dimensions of the sample space can be seen in Table 6.1.

Table 6.1: Edinburgh Assessors' Attributes with Correlation Coefficients of ≥ 0.65 for Dimensions 1 to 5

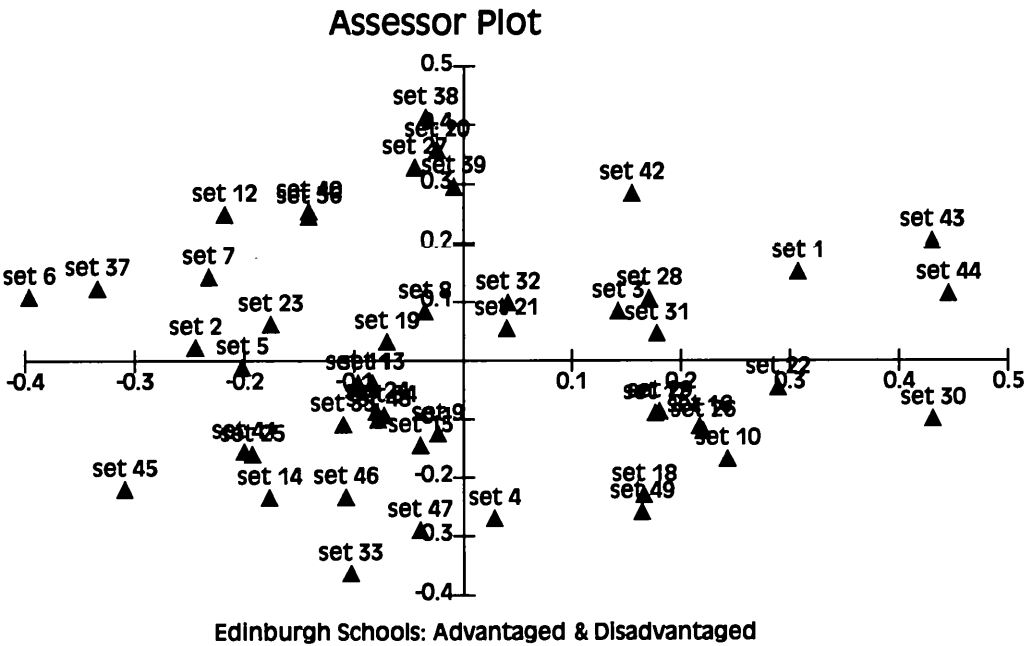
Dimension 1 (31% total variance)	Dimension 2 (19% total variance)	Dimension 3 (16% total variance)	Dimension 4 (14% total variance)	Dimension 5 (8% total variance)
Crunchy (-11) Hard (-9) Dice/Cut-up (-7) Big (-6) Raw (-5) Peel (-5) Grow outside (-4) Like (-2) Soft (+16) Sauce (+12) Tin/Packet (+11) “Fry-up” (+11) Chips (+10) Squashy (+9) Toast (+9) Small (+8) Juicy (+5) Flavoursome (+5) Hot/cooked (+5) Fish (+4) Meat (+4) Like (+8)	Juicy (-10) Salad (-9) Seeds/Pips (-7) Sweet (-6) Raw (-5) Sandwiches (-5) Pizza (-4) Home-grown (-3) Watery (-3) Soup (-3) Tin/Packet (-3) Tasty (-3) Wash (-3) Vitamins (-3) Like (-5)	Salad (-4) Sweet (-2) Soft (-2) Horrid taste (-2) Like (-1) Meat (+6) Crunchy (+5) Nice taste (+5) See in dark(+4) Casserole (+4) On its own (+3) Raw (+3) Like (+6)	Nice taste (-3) Lunch (-3) Sweet (+3) Sunday (+3) Chewy (+3) Preparation (+3) Evening meal (+3) Like (+4)	Haggis (-8) Halloween(-5) Sweet (-3) Juicy (-2) Peeled (-2) Like (-1) Like (+1)

Note: Figures in brackets indicate the number of assessors significantly rating the attributes as important, whilst the sign denotes the axes of the perceptual space with which the attribute is correlated.

Figure 6.1 shows the assessor plot with sets 1- 25 representing the children from the disadvantaged area, and sets 26-49 representing the advantaged children. It is not clear from the assessor plot whether the advantaged and disadvantaged groups perceived the samples differently (there are no clear clusters of one or other socio-economic status).

There was good consensus amongst the assessors, i.e. they perceived and scored the samples in a similar manner. However, the assessor residuals for Assessor 38 for Dimensions 1 and 2 are much higher than for the other assessors, suggesting that this child's perceptions of the vegetables are different from the consensus. Also, examining the weights (scaling factors) for each child, Assessor 38's data has the largest weight over 1 (1.86), which shows that he used a smaller range of the scale compared to the rest of the children. This leads to the conclusion that this assessor is an outlier, and examining the data showed that he used many fewer attributes (n=6) than the other children to describe the sample space.

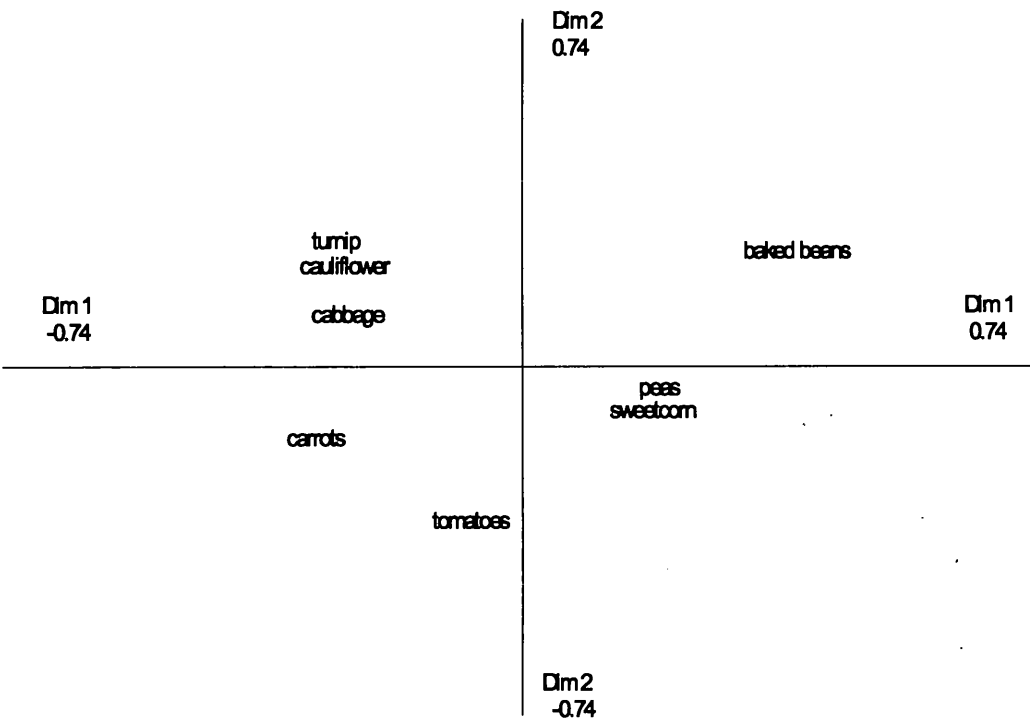
Figure 6.1: Assessor plot derived from GPA of free-choice profile data. Sets 1 to 25 are the disadvantaged assessors, Sets 26–49 are the advantaged assessors.



The sample plot of the first two dimensions of the sample space, accounting respectively for 31% and 19% of the total variance, can be seen in Figure 6.2. Dimension 1 relates to the sensory qualities of the vegetables; especially textural properties (significantly cited 49 times), necessary sample preparation, manner of eating (e.g. raw, hot), appropriateness

for eating with other foods, and miscellaneous other factors (e.g. tinned/packet, size).

Figure 6.2: Dimension 1 (31%) and Dimension 2 (19%) of the sample consensus space.



Dimension 1 separates the vegetables into two groups, with baked beans, peas and sweetcorn associated with the positive axis, and turnip, cauliflower, cabbage and carrots associated with the negative axis. Tomatoes were not strongly associated with either axes of Dimension 1, lying close to the origin of the consensus space. This is indicative of poor agreement among the assessors for that Dimension (Dijksterhuis and Punter, 1990) with regard to their perception of tomatoes. Examination of the Procrustes analysis of variance (PANOVA) results per object (Table 6.2) shows that tomatoes have the lowest total (consensus) variance of all the vegetables (0.61%) and a very large residual variance (93.4%) for Dimension 1. Conversely, baked beans are the sample with the strongest

level of agreement between the assessors.

Table 6.2: Total (consensus) and residual variance for Dimensions 1 to 4 distributed across the eight samples.

	Dim 1		Dim 2		Dim 3		Dim 4	
	Resid	Total	Resid	Total	Resid	Total	Resid	Total
Baked beans	0.40	11.07	0.29	2.63	0.25	0.42	0.39	3.98
Carrots	0.72	4.07	0.41	2.02	0.74	8.26	0.24	0.88
Tomatoes	0.57	0.61	0.51	6.73	0.47	4.24	0.35	2.08
Cauliflower	0.39	2.51	0.39	2.12	0.25	0.38	0.14	0.15
Turnip	0.55	3.39	0.46	3.27	0.33	0.53	0.19	0.28
Cabbage	0.38	2.41	0.40	0.74	0.34	1.11	0.19	0.28
Sweetcorn	0.45	3.29	0.28	1.00	0.33	0.33	0.34	2.68
Peas	0.59	3.28	0.39	0.64	0.35	0.50	0.17	3.40

Carrots, cabbage, cauliflower and turnip (the vegetables correlated with the negative axis of Dimension 1) were perceived to be large-sized vegetables that were crunchy and hard, and required cutting-up before cooking or eating. The children also perceived these four vegetables to need peeling prior to eating, and to suit eating raw as well as cooked. These vegetables were perceived as “growing outside”, which contrasts with the tinned/packet (i.e. processed) vegetables associated with the positive axis of the first dimension. The hedonic scores of only two children correlated with this axis.

Baked beans, peas and sweetcorn were associated with the positive axis of the first dimension, with peas and sweetcorn being perceived in a very similar manner (shown by their close proximity to each other on the consensus plot, Figure 6.2). The children thought of these vegetables as being soft and squashy, and small in size. These were all vegetables which either came in a sauce (baked beans) or were often eaten with a sauce (usually said to be tomato ketchup); attributes which were frequently cited. The scores for eleven of the children (all from the disadvantaged area) on their personal scales for the constructs ‘tinned’ or ‘packet’ significantly correlated with this axis of Dimension 1. This shows that the baked beans, peas and sweetcorn were associated with being processed

(tinned, or frozen if in packets) which contrasts with the perception of the other vegetables at the opposite axis of this dimension as being 'unprocessed'. The baked beans, peas and sweetcorn were thought of as juicy and full of flavour by five of the assessors, and the children perceived that these three vegetables needed to be eaten hot (cooked). In response to the question, "When would you eat these vegetables?" peas, sweetcorn and baked beans were perceived to be eaten with a "fry-up" (fried bacon, sausage and egg), chips, on toast (for baked beans) and with fish or meat. These properties appear to be ones that are attractive to young children, as the hedonic scores of eight assessors significantly correlated with this axis.

Baked beans, turnip, cauliflower and cabbage were perceptually grouped together along the positive axis of Dimension 2, although no attributes were significantly associated with this axis. At the negative end of the Dimension, peas and sweetcorn were closely situated next to each other, along with carrots and tomatoes. These four vegetables were perceived to be juicy, although watery (which may suggest the lack of a strong flavour). The flavour of these vegetables was described as sweet, and tasty, and the children thought of carrots and tomatoes as suitable for eating raw. Preparation-wise, when fresh these four vegetables all needed washing before they could be eaten. All four vegetables could also be processed and were associated either with being tinned or from a packet (this latter attribute again being mentioned only by the disadvantaged assessors). With regard to the usages for these vegetables, the assessors perceived them as being suited to salads, for eating in sandwiches, making soup out of, and for putting on pizzas. One characteristic that the children associated with tomatoes was the presence of seeds ("pips"). Although five children's hedonic scores did strongly correlate with these vegetables (i.e. liked), the preference score for tomatoes is not high (Table 6.4), suggesting that the presence of pips was off-putting to some children.

Figure 6.3 shows the sample consensus plot for Dimensions 3 and 4. The consensus among the assessors with regard to Dimension 3 (the horizontal axis) was not good, other than for carrots, tomatoes and cabbage. For Dimension 4 (the vertical axes in Figure 6.3) there was poor agreement among the children with regard to their perceptions of cauliflower, turnip and cabbage. This is evident from the positioning of the samples close to the origin of the sample space, and also from the high residual variance within the data for these vegetables.

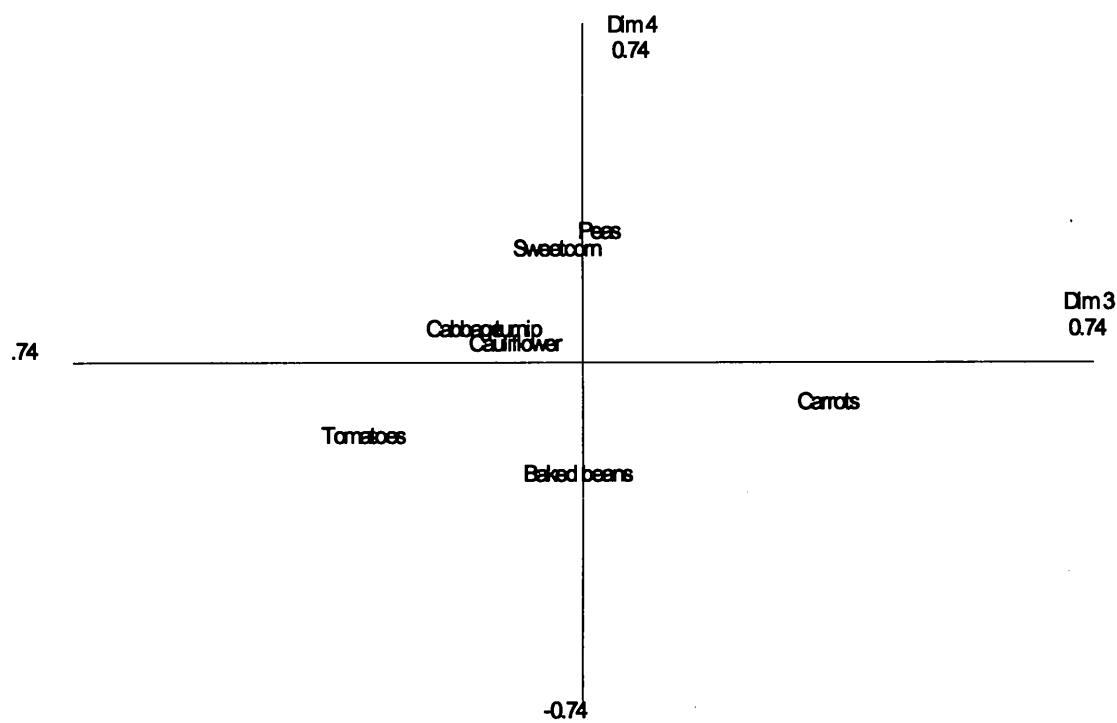


Figure 6.3: Dimension 3 (16%) and Dimension 4 (14%) of the sample consensus space.

Those vegetables associated with the negative axis of Dimension 3 (tomatoes, and cabbage) were perceived to be for use in salads, to be soft in texture, taste sweet, but were also said by some assessors to taste horrible. Only one child's hedonic scores corresponded significantly with this axis of Dimension 3. Carrots were the only

vegetables showing good consensus along the positive axis of the third dimension, and were uniquely perceived to be suited for eating with meat, or in casseroles, or on their own as a snack. The crunchy texture was commented upon, and this relates to the children's perception of carrots as suited to eating raw. The children had also learnt the association between carrots and the role of vitamin A in the maintenance of night vision, talking about carrots as "helping you to see in the dark". Finally, carrots were perceived to be tasty which influenced the children's preference for these vegetables.

Dimension 4 has baked beans, carrots and tomatoes grouped according to their association with the negative axis. These were perceived to be vegetables with a nice taste, and which could be eaten at lunchtime. Along the positive axis, peas and sweetcorn were together perceived to be sweet tasting and chewy. These two vegetables were described inter-changeably as requiring preparation prior to eating, and to be good accompaniments to both Sunday lunch, and the main evening meal during weekdays. These attributes associated with peas and sweetcorn particularly appealed to four of the assessors, as demonstrated by their preference scores.

GPA Group Average : dimension 4 (X axis) versus 5 (Y axis)

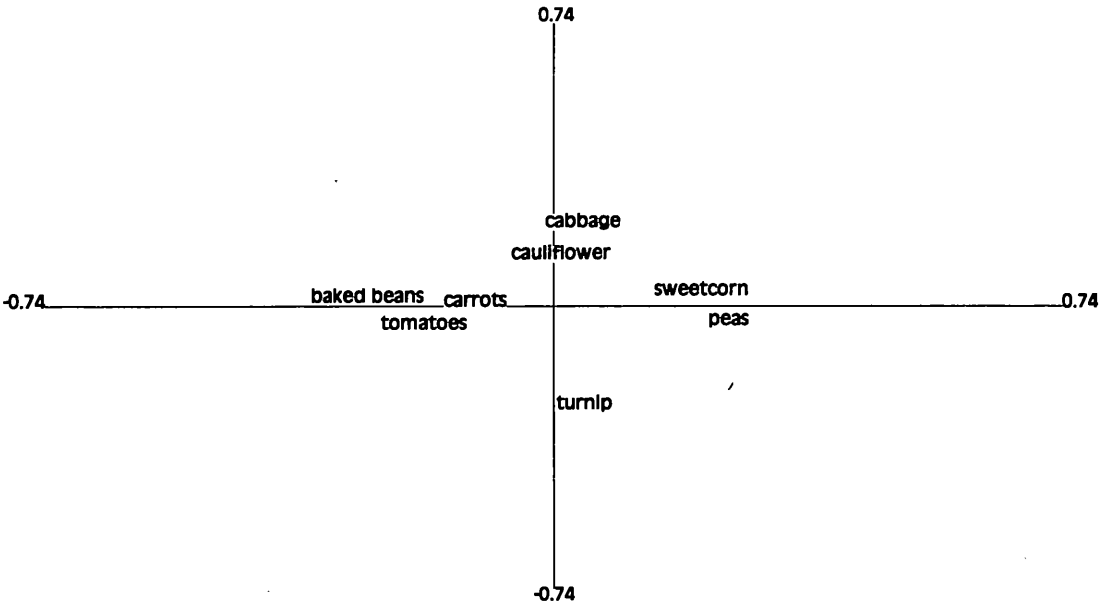


Figure 6.4: Dimension 4 (14%) and Dimension 5 (8%) of the sample consensus space.

Dimension 5 of the sample consensus space is of interest because it particularly relates to the properties associated with turnip (swede). No attributes significantly related with the positive axis (cabbage and cauliflower) although one hedonic response did. Those attributes associated with the negative axis solely describe turnip as the vegetable to accompany haggis, as being suited to carving out for use as a lantern at Halloween, as requiring peeling prior to cooking, and as tasting sweet and juicy. Only one assessor liked turnip for this Dimension. In Scotland, a dinner consisting of haggis, potatoes and turnip (better known to locals as “haggis, tatties and neeps”) is traditionally used to celebrate the birth of the Scots poet Robert Burns, explaining the strong connection the children made between turnip and haggis. The consensus sample space can be seen in Figure 6.4.

6.4.2 Self-Reported Vegetable Consumption

Having completed the scoring of their personal constructs, the children were asked to complete a short questionnaire about their typical vegetable consumption. Twenty disadvantaged assessors returned completed questionnaires, as did 23 of the advantaged children. No child of either socio-economic status said that they “never” ate any vegetables. Table 6.3 shows the reported weekly consumption for each group.

The higher proportion of disadvantaged children claiming a consumption frequency of between 4-6 times per week is probably due to the school’s policy of encouraging consumption of vegetables with the school meal. Ninety-four percent (n=17) of the disadvantaged children said they ate school dinners, with 100% of these children eating vegetables with the dinner. At the advantaged school, 58% (n=14) of the children said they ate the school meal, of which 57% (n=8) ate vegetables with it. A chi-square analysis showed that there were no significant differences ($p=0.173$) between the reported weekly vegetable consumption of the two groups of assessors. An analysis of the reported weekly consumption by gender also showed no significant differences.

Table 6.3: Reported weekly vegetable consumption by socio-economic status (SES)

SES 1 = advantaged assessors; SES 7 = disadvantaged assessors. The number of returned questionnaires from each group is shown in brackets.

Reported weekly Vegetable consumption	SES 1 (n=23)	SES 7 (n=20)
Every day	5	4
4 – 6 times	9	12
2-3 times	7	3
Once a week	2	1
Never	0	0

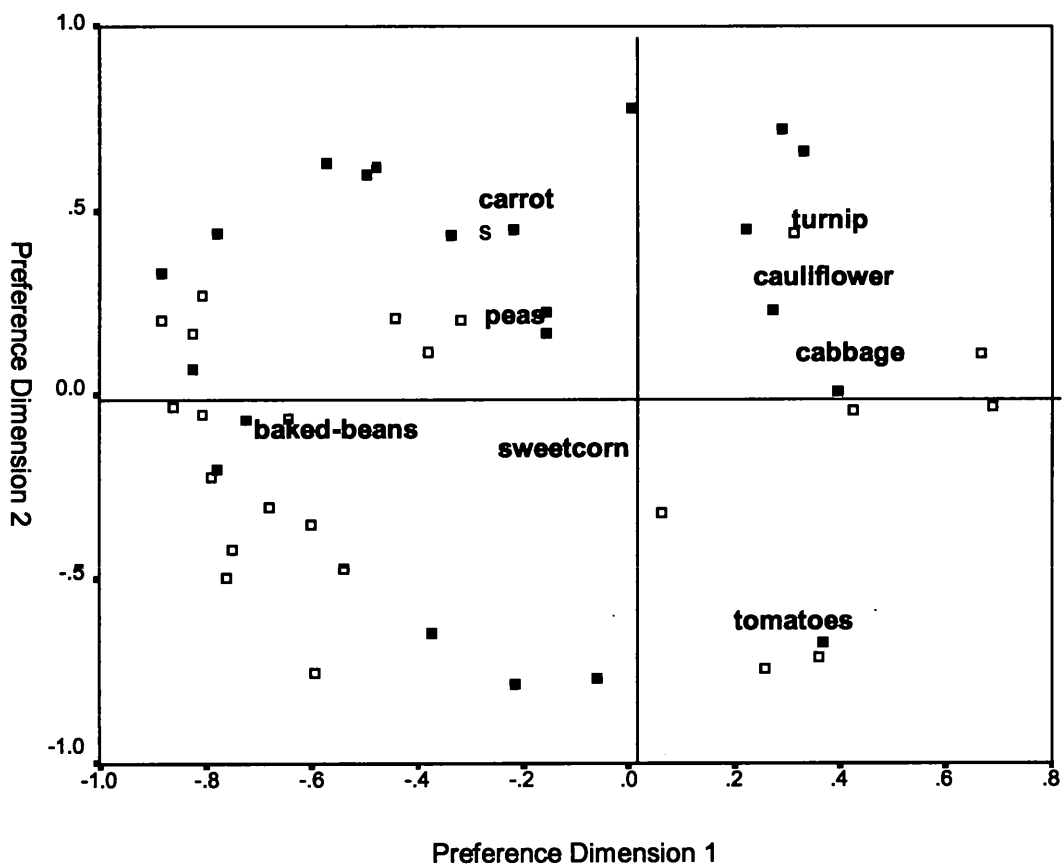
6.4.3 Results of the Analysis of the Preference Scores

All the children had scored the eight vegetables for preference whilst scoring for their personal constructs. The order of the hedonic question on the scoresheet was randomised among the children to reduce bias due to previous questions (Earthy *et al.*, 1997). An internal preference map of the hedonic scores of the assessors was constructed (Figure 6.5) using Senpak version 2 (RSSL, Reading, UK) based on the data from 45 of the 49 assessors. Four assessors were excluded from the preference map, as they had not discriminated between the samples when scoring their preferences, scoring all samples at one of the extremes of the scale.

The preference map (Figure 6.6) shows that the children were segmented according to their socio-economic status. The assessors whose preference scores were in the top two sectors (containing carrots, peas, turnip, cauliflower and cabbage) were predominantly of low socio-economic status, whereas those in the bottom sectors (containing baked beans, sweetcorn and tomatoes) were mainly from the high socio-economic status group.

Pearson's chi-square analysis of the socio-economic status of the assessor by the preference map sector (top half versus bottom half) showed that these observed differences were statistically significant ($p < 0.05$). Due to the low number of assessors of one or other socio-economic status in some quadrants of the preference map, it was not possible to perform a chi-square analysis in greater detail. However it can be seen from the preference map that there were more advantaged assessors associated with tomatoes, and also with baked beans and sweetcorn, whilst the assessors clustered around the trio of turnip, cauliflower and cabbage were mainly from the disadvantaged school.

Figure 6.5: Internal analysis on vegetable acceptance scores of assessors who are significantly fitted on preference dimensions 1 and 2.
Assessors are labelled by socio-economic status (■ = disadvantaged, □ = advantaged).



The preference scores were analysed using SPSS (SPSS v. 6.1; SPSS Inc., Chicago, 1993) to identify any differences in the children’s liking for the vegetables. Friedman’s two-way ANOVA showed that the children’s preferences for the vegetables were not equal ($p<0.001$) with carrots being the most liked vegetable, and cauliflower the least (Table 6.4). The large standard deviations associated with the mean preference scores demonstrate the large differences in opinion between assessors with regards to their

preferences for each vegetable.

Table 6.4: Friedman two-way ANOVA results ($p<0.001$) from the Edinburgh study.

Preferences were scored on 10cm linear scales where 0 = not like at all; 10 = like extremely.

Vegetable	Mean Preference Score	Std. Deviation	Mean Rank for Preference
Carrots	6.64	4.01	5.39
Sweetcorn	6.44	3.68	5.33
Baked Beans	6.33	4.48	5.14
Peas	6.02	3.69	4.91
Turnip	3.91	3.94	3.96
Tomatoes	4.33	4.15	3.90
Cabbage	4.06	3.86	3.70
Cauliflower	3.68	3.91	3.67

Before examining the data for any differences in preferences due to socio-economic status, the Kolmogorov-Smirnov test for normality was applied to the distribution of the children's' scores for each of the eight vegetables. The preference scores of only four of the vegetables were found to be normally distributed. Parametric tests could therefore not be used with this data, and the Mann-Whitney test was used instead.

Table 6.5 shows the results of the Mann-Whitney test for each of the samples by socio-economic status (SES). The mean rank shows which group of children preferred the vegetables (given that with the scales used, 0 = not like at all, 10 = like extremely). The disadvantaged children (SES 7) significantly liked cabbage, cauliflower and turnip more than the advantaged children (SES 1). There were no significant preferences among the advantaged group. Baked beans, carrots, sweetcorn, peas and tomatoes were liked equally by both groups of children, and the mean scores (Table 6.4) show that they were all (with the exception of tomatoes) scored in the "liking" portion of the preference scale.

Independent *t*-tests of the preference scores by gender did not show significant

differences between the boys' and girls' preference scores for any of the vegetables. This is despite a bias towards female assessors at the disadvantaged school resulting in a total of 28 females compared to 21 males in this study. Likewise, no significant differences in preferences for any vegetables were found between those children who reported eating vegetables 0-3 times per week, and those that said they ate them more frequently. It should be borne in mind that some children might have deliberately over-reported their vegetable consumption due to awareness of the benefits of eating vegetables, so as to appear to be behaving in a socially desirable manner. This may explain the absence of correlation between preference and reported consumption.

Table 6.5: Results of Mann-Whitney tests on preference scores by socio-economic status (SES).

*[†] SES 1 = advantaged assessors; SES 7 = disadvantaged assessors.
For level of significance: ns = non-significant, * = $p<0.05$.*

Vegetable	SES [†]	Mean Rank	2-tail sig.	Sig. level
Baked Beans	1	24.20	.880	ns
	7	24.78		
Cabbage	1	19.72	.022	*
	7	28.90		
Carrots	1	25.30	.698	ns
	7	23.76		
Cauliflower	1	20.26	.041	*
	7	28.40		
Peas	1	22.74	.399	ns
	7	26.12		
Sweetcorn	1	27.61	.136	ns
	7	21.64		
Tomatoes	1	28.54	.052	ns
	7	20.78		
Turnip	1	19.89	.026	*
	7	28.74		

6.5 Discussion

6.5.1 Socio-Economic Status

It is evident from this study that overall there were many similarities in the two groups (advantaged and disadvantaged) of assessors' perceptions of the sample vegetables. For example, both groups of assessors perceived baked beans, sweetcorn and peas to be similar, on the basis that they were juicy, mushy, came in a sauce or went well with sauce, and were suited to eating with sausages and with chips. Likewise, both groups perceived carrots, turnip, cabbage and cauliflower as being hard and crunchy. On the first dimension, textural properties were the main factor for separating the samples, with the vegetables perceived to be soft, juicy and flavoursome preferred to those that were hard and crunchy.

This is the opposite result to that obtained from an earlier study with English children of the same age (Baxter *et al.*, 1998) where the subjects preferred crunchy, hard vegetables (although the samples were slightly different). Early research into children's attitudes to food texture (Szczeniak, 1972) had suggested that this sensory property was of utmost importance in foods that display crisp or crunchy characteristics, whereas flavour was the principal attribute in foods which are strongly flavoured or soft. The results from this Edinburgh study support Szczeniak's hypothesis regarding children's awareness of food texture, with soft vegetables being additionally perceived as 'flavoursome', whilst crunchy vegetables were described in relation to their textural properties, but not their flavour.

In terms of correlations between preferences and attributes associated with particular vegetables, both the advantaged and the disadvantaged assessors liked the trio of baked beans, sweetcorn and peas. For these vegetables, liking was associated with them being juicy, mushy, small, and served with sauce, and with sausage and chips. Interestingly, the combination of attributes "sausage/chips/egg" were significantly mentioned by 18 out of 25 assessors from the disadvantaged group, compared to just 7 out of 24 of the

advantaged assessors. Possibly the disadvantaged group consumed more fried food than the advantaged group, explaining the differences in the frequency with which this attribute was mentioned. However, dietary records were not used in this study, so this suggestion cannot be substantiated with any data. A study of Scottish adolescents (Anderson *et al.*, 1994a) found significant ($p<0.001$) correlations between socio-economic status and being a “healthy eater” (having a fat ‘score’ (based on consumption) less than their carbohydrate ‘score’). This study by Anderson *et al.* (1994a) found that a greater proportion of the lower socio-economic status adolescents were ‘less healthy’ eaters, and more of the advantaged subjects were ‘healthy eaters’, which might also be true of the assessors in the present study.

As well as similarities in the two groups’ perceptions of the samples, there were also noticeable differences. Assessors from the advantaged area perceived carrots and tomatoes to be suitable for eating raw (mentioned significantly by 42% of the high socio-economic status group) and for use in soups (significantly mentioned by 21%) and associated these attributes with liking. Whilst during construct elicitation these attributes were cited by some assessors from the disadvantaged area, fewer low socio-economic status assessors significantly scored these constructs (24% significantly citing “raw”, and 4% “soup”). The time of year when the studies took place may have influenced the children’s perception of the soup-making properties of the vegetables. The advantaged school study occurred in March (late winter/early spring) when soup consumption is likely to be higher due to the cold climate, whilst the data from the disadvantaged school was collected in May (early summer) of the same year. The consumption of raw vegetables might be an effect of socio-economic status, with this behaviour perhaps being more common among those of higher socio-economic status, as suggested by this study.

The disadvantaged group frequently commented on the packaging of the vegetables i.e. tinned or in packets. This attribute was important to this group (56% of the assessors significantly cited this attribute, with a further two citing it non-significantly). However, packaging was never mentioned during construct elicitation by any assessors in the

advantaged group. The photograph of the vegetables that were in tins or packets may have influenced the disadvantaged assessors, yet it is remarkable that it did not influence the other group. It seems more likely that the low socio-economic status children consumed more tinned/package (i.e. processed) vegetables than their advantaged peers, as is demonstrated by the 1996 National Food Survey (MAFF, 1997; Table 2.19).

The advantaged assessors also significantly mentioned “home-grown” as an attribute, which was not cited by any of the low socio-economic status assessors. The areas in which both schools were situated may explain these differences in perceptions of ‘processed’ and ‘natural’ vegetables. The area surrounding the advantaged school does include some tenement flats, but mainly comprises owner-occupied houses with gardens. There are two local greengrocer shops and a large top multiple retailer on the nearby main road; all offering a large range of quality produce, including organic and ‘exotic’ vegetables. In contrast, the disadvantaged school is situated in the middle of a council housing scheme where all the accommodation is in flats, and none have a private garden. The local shop is a small convenience outlet with a limited selection of fresh vegetables, and the nearest supermarket is a top multiple retailer specialising in frozen produce. So it would be unsurprising if the disadvantaged children did consume more processed vegetables than fresh, and they are highly unlikely to have home-grown produce.

“With potatoes” other than chips, was seen to be an important attribute for the disadvantaged group of children. This contextual attribute was significantly cited by nine of the 25 disadvantaged assessors, and was additionally mentioned during the RGM interview (non-significantly) by a further four assessors. Three of the advantaged assessors mentioned “with potatoes” during RGM, but this attribute was only significant for one child from this group. It is apparent from the 1995 National Food Survey (MAFF, 1996; Table 5.8, page 79) that lower-income households do consume more potatoes (non-processed) than those households with higher incomes. This provides a good explanation of the significance of “with potatoes” as a construct for the disadvantaged assessors.

In terms of 'attractive' vegetable attributes, it appears that all these children like vegetables with the properties they perceived to be present in baked beans, sweetcorn and peas. The advantaged group additionally liked carrots and tomatoes, which they perceived to be eaten raw, in salads, in soups and to be healthy, and full of vitamins. It may be that these properties would also be attractive to the disadvantaged children, but that few of them had experienced eating these vegetables in these ways so did not significantly cite them. Previous studies of children's food preferences have suggested that sweet foods are typically favoured over bitter-tasting foods (Ton Nu *et al.*, 1996; Ross, 1995), which mirrors the innate food preferences and aversions of neonates (Steiner, 1977). The three vegetables commonly liked by all children (baked beans, peas and sweetcorn) are all sweet tasting. The favourite four vegetables (carrots, sweetcorn, baked beans and peas), as shown by the mean consensus preference scores (Table 6.4), are by nature sweet, whereas cabbage and cauliflower, which were among those least liked, could be described as bitter.

Ton Nu *et al.* (1996) found that their younger subjects disliked green vegetables (including cabbage), but learnt to like them as they reached adolescence as a result of social motivations to try previously rejected foods. The French subjects were older than the average participant in this Scottish study, and it is possible that present assessors' preferences for the bitter vegetables will also increase as they reach adolescence. Young children's inherent aversion to bitter tastes (Steiner, 1977) and likely limited exposure to bitter foods (Baxter and Schröder, 1997), suggests that according to the theories of Birch and colleagues (Birch *et al.*, 1987; Birch and Marlin, 1982; Birch *et al.*, 1982), it is likely that they will reject bitter tasting vegetables. This may explain the lower preference scores for the cabbage and cauliflower, among other vegetables, as found in this study.

Recent studies in the USA examining adults' perceptions of vegetables (Kleim *et al.*, 1997; Drewnowski, 1996) have also found preference to be most influenced by taste, with the most disliked vegetables in Drewnowski's study being perceived as bitter-tasting. In common with the findings of the present study, both US studies found that the

most preferred vegetables were also perceived to be versatile and could be eaten with many dishes. Drewnowski found that the adults associated bitterness with children's dislike for such vegetables, reinforcing the belief that bitterness in green vegetables is a barrier to their consumption by children. Parental beliefs regarding their child's food likes/dislikes, or their acceptance of the child's stated dislike of a particular food may prevent the child consuming the 'disliked' food (Horne *et al.*, 1998). This in turn might prevent the child receiving sufficient exposure to that food, which might have led to an increased preference (Birch *et al.*, 1987; Birch and Marlin, 1982; Birch *et al.*, 1982).

Interestingly, the disadvantaged children in the present study liked cabbage, cauliflower and turnip significantly more than did their advantaged peers. Possibly, in the disadvantaged area it was easier to access these three vegetables, as opposed to the other samples. Limited accessibility to quality produce in areas of social deprivation has previously been suggested as a barrier to vegetable consumption in Scotland (Anderson *et al.*, 1996).

A second possibility is that the disadvantaged children had more frequent exposure to these vegetables, either because of parental/familial preferences, or due to their inclusion in the school meals, which the majority ate. As previously discussed, this greater exposure to these vegetables could lead to the acceptance of a previously disliked vegetable (Birch and Marlin, 1982). Detailed consumption data from the assessors was not collected during this study, so it is not known if this is indeed the case. Whilst the 1995 National Food Survey (MAFF, 1996; Table 5.8) showed that per occupant consumption of fresh green vegetables was higher in disadvantaged households than in advantaged homes (with the exception of the very advantaged households), the 1996 results do not support this theory (MAFF, 1997; Table 2.19).

6.5.2 Gender

Gender was not found to significantly influence the assessors' consumption of, or preferences for the vegetables in this study. Earlier research (James *et al.*, 1997) found

there to be no gender related differences in taste sensitivity in Australian children aged 8-9 years. This suggests that these Scottish children might also perceive the same intensity of bitterness or sweetness in the vegetables, possibly explaining the lack of gender-related preferences.

With respect to consumption, previous studies of UK adolescents and adults have found females to be more likely to claim to eat any salad or vegetable than males (Hackett *et al.*, 1997; Anderson *et al.*, 1994b). Girls were also found to be significantly ($p<0.01$) more aware of the health benefits of consuming vegetables than boys in an earlier study of English adolescents (Lund *et al.*, 1990). This suggests that girls find the dietary and associated weight-controlling properties of appealing and subsequently have positive perceptions of vegetables. One might therefore expect girls to consume more vegetables than do boys, causing their preferences to increase in line with exposure (Birch *et al.*, 1982).

The results from these earlier studies would suggest that there are gender differences in relation to attitudes towards, and preferences for vegetables, and the absence of such a result from this research is surprising. However, the data of just 49 children was considered and possibly gender differences in consumption and preferences will be observed once further data becomes available for analysis. Additionally, it might be that at the age of the children studied, girls are not yet any more body conscious than are boys.

6.6 Conclusions

Due to the relatively small number of samples that can be used with children for the purposes of RGM, the results from this study can not provide a definitive account of children's perceptions of vegetables. Rather, the results reveal favourable characteristics associated with these eight vegetables which influenced preference and might also be extrapolated to other vegetables which have similar properties.

In total, 49 Edinburgh children provided detailed information about their perceptions of the vegetables, which is a sufficiently sized population for a RGM study to provide meaningful results. It was shown that there were differences in the children's perceptions and preferences of the vegetables due to their social background.

Note

This chapter is based on a previously published paper:

Baxter, I.A., Schröder, M.J.A. and Bower, J.A. (1999). The influence of socio-economic background on perceptions of vegetables among Scottish primary school children. *Food Quality and Preference*, 10 (4/5), 261-272.

CHAPTER SEVEN: THE INFLUENCE OF CONTEXTUAL FACTORS ON PERCEPTIONS OF AND PREFERENCES FOR VEGETABLES AMONG GLASGOW PRIMARY SCHOOL CHILDREN FROM SOCIALLY DISPARATE BACKGROUNDS.

7.1 Introduction

Within Scotland, variations in premature coronary heart mortality rates between different health board regions are evident. The West of Scotland, and Glasgow in particular, has a particularly high rate of coronary heart mortality, which has been linked in part to the population's low intake of fruit and vegetable (Tunstall-Pedoe *et al.*, 1989; Anderson and Hunt, 1992; Forsyth *et al.*, 1994). There are interesting disparities in both coronary heart disease mortality rates and fruit and vegetable intakes between adjacent areas within North Glasgow (Tunstall-Pedoe *et al.*, 1989; Crombie *et al.*, 1986). Socio-economic status is a probable factor, with low coronary heart disease mortality/high fruit and vegetable intakes being found in the advantaged area and vice-versa in the neighbouring disadvantaged area.

Recently, in a bid to improve Glaswegians' diet, the Greater Glasgow Health Board appointed a nutritionist to work in a supermarket in a disadvantaged area of Glasgow, encouraging consumers to purchase more fruit and vegetable and to offer advice on preparation methods (The Scotsman, 3rd February 1999; page 1). This illustrates the seriousness of the problem of nutritionally deficient diets prevalent in many areas of Glasgow, especially with respect to inadequate fruit and vegetable intakes.

By selecting a primary school within an area with low fruit and vegetable consumption and contrasting it to a school from an area with a typically high fruit and vegetable intake it was expected that differences in children's perceptions of vegetables would become apparent. Additionally, this research was designed to examine the importance of sensory factors (in particular textural properties) and preparation methods in relation to the children's vegetable preferences and consumption.

7.2 Materials and Methods

7.2.1 Assessors

The assessors were children aged between 8-10-years old from Primary 4 classes of two schools in North Glasgow. The chosen schools were in socially disparate areas of the district, as indicated by the deprivation category (DEPCAT) scores assigned to the postcode sector of the school and surrounding residential area. The 'advantaged' school (DEPCAT 1) is in an area with very low coronary heart disease mortality rates and high fruit and vegetable consumption (Milngavie), whilst the 'disadvantaged' school (DEPCAT 7) is located in an area with a particularly high coronary heart disease mortality rate and typically low fruit and vegetable consumption (Drumchapel). Strikingly, the chosen areas are adjacent with only a street separating the advantaged area from the disadvantaged area, although the schools were not so close together.

There were 23 children at the advantaged school (of which 22 children's data was used), and 21 at the disadvantaged school (of which 20 children's data was used). All the children on the school roll at the disadvantaged school received free school meals, while none of the pupils from the advantaged schools were eligible. Of the 22 advantaged assessors, 13 were male and 9 were female. At the disadvantaged school, 10 of the assessors were male and 10 female.

7.2.2 Samples

The selected samples were: baked beans, carrots, tomatoes, peas, sweetcorn, cabbage, cauliflower, turnip (a.k.a. swede). For further information on the samples, refer to Chapter 4.

7.2.3 Procedure

Kelly's (1955) repertory grid method (RGM) was used as an interview technique to obtain information pertaining to the assessors' perceptions of the vegetables as for Chapter 6. For further information on the RGM procedure as used, refer to Chapter 4. Assessors were given personalised score sheets containing 10cm linear scales representing each of their constructs as described in Chapter 6.

Data from the score sheets were analysed by Generalised Procrustes Analysis (GPA) using Senstools for Windows v2.2 (OPandP and Talcott, Utrecht, The Netherlands). An internal preference map was constructed from the hedonic data using Senpak v2.0 (RSSI, Reading, UK).

7.3 Results

7.3.1 Results of the Generalised Procrustes Analysis

The advantaged assessors generated between 11-22 constructs (mean of 16), while the disadvantaged assessors produced between 7-21 constructs (mean of 13). GPA of the data produced four dimensions that explained the perceptual differences between the samples, accounting for 79% of the total variance. Assessors' descriptors having an absolute correlation of ≥ 0.65 with the first four dimensions of the sample space can be seen in Table 7.1.

Table 7.1: Children's attributes with correlation coefficients of ≥ 0.65 for Dimensions 1 to 4.

Dimension 1 (33%)	Dimension 2 (18%)	Dimension 3 (15%)	Dimension 4 (14%)
Tinned (+20) In/with sauce (+13) Soft/mushy (+12) Like (+10) Small (+8) With chips (+8) With pies (+7) With sausages (+7) Juicy (+6) With toast (+6) With fish-fingers (+5) With chicken nuggets (+4) With meat (+3) With pizza (+2) With potato waffles (+2) Big (-15) Grows outside (-10) Crunchy (-7) Leafy (-7) Hard (-5) Needs peeling (-5) With salad (-4) "Yucky" (-3) Special meals (-2) Healthy (-2) In plastic bags (-2) In soup (-2) With meat (-2) Eat cold (-2)	Has seeds (+10) Juicy (+5) With salad (+4) In sandwiches (+4) Raw (+2) Eat on its own (+2) Needs cutting up (+2) With meat (+2) Like (+2) Green (-19) Has vitamins (-2) Has leaves (-2)	With salad (+4) Grows outside (+4) Like (+4) Green (+3) With fish and chips (+3) In a packet (+3) Sweet (+2) Juicy (+2) In sandwiches (+2) In/With sauce (-13) With pies (-5) With toast (-5) With chips (-4) With sausages (-4) With chicken nuggets (-3) With potatoes (-2) Like (-2)	Like (+8) With mince and potatoes (+7) Crunchy (+4) With chicken (+4) With potatoes (+3) With fish and chips (+2) See in the dark (+2) Has seeds (-7) Round (-2) "Squishy" (-2) Juicy (-2) In sandwiches (-2) In salads (-2)

Note: Figures in brackets indicate the number of assessors significantly rating the attributes as important, whilst the sign denotes the axes with which the attribute is correlated.

The assessor plot (Figure 7.1) represents the advantaged children as sets 1-22, with sets 23-42 representing the disadvantaged children. There is no clear differentiation between the children of either socio-economic status. Generally there was good consensus among

these Glasgow children, i.e. they perceived and scored the samples in a similar manner, irrespective of socio-economic status. From Figure 7.1, it appears that assessors 6 and 8 are outliers and scrutiny of the Procrustes analysis of variance (PANOVA) residual variance shows that both these assessors have high assessor residuals for Dimension 1, as does assessor 3. This tells us that these three assessors' individual configurations of the samples differ the most from the group consensus. The weights (stretching/shrinking factors) show that assessor 3 with the smallest weight (0.34), used the largest range of scores (Dijksterhuis, 1996) and had his configuration shrunk the most. All of the three assessors were from the advantaged school, but examining their correlation data no obvious discrepancies explain their status as outliers.

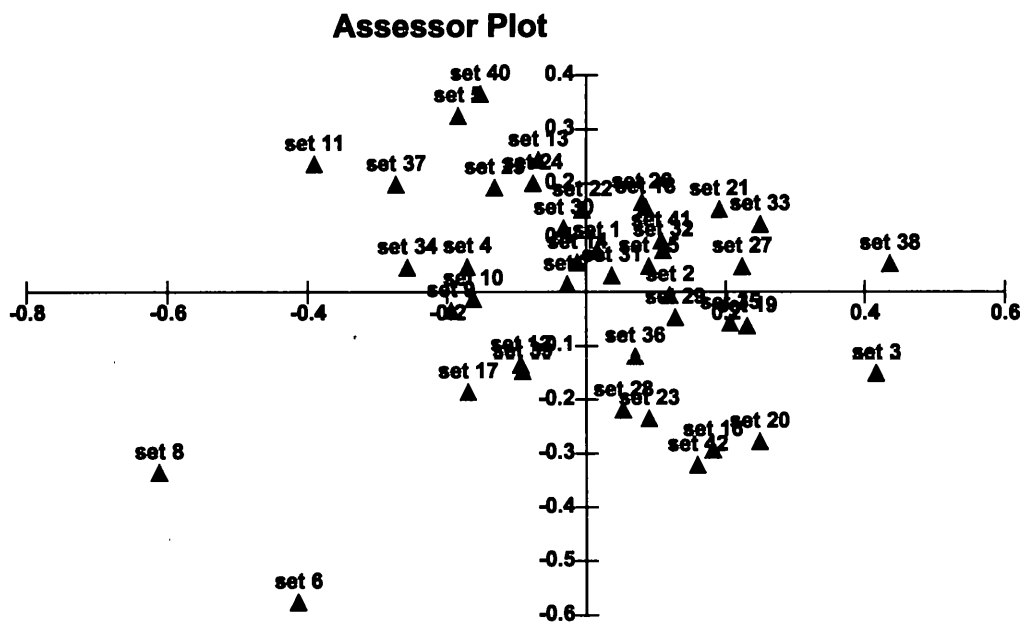


Figure 7.1: Assessor plot of Glasgow children. Sets 1 to 22 are the advantaged assessors, sets 23 to 42 are the disadvantaged assessors.

The first two dimensions of the sample space, accounting for 33% (Dimension 1) and 18% (Dimension 2) of the total variance, are shown in Figure 7.2. On Dimension 1, the vegetables are separated according to their size and texture, with small, soft and juicy

vegetables (sweetcorn, peas, baked beans and tomatoes) associated with the positive axis and large, hard and crunchy vegetables (cauliflower, cabbage, turnip and carrots) at the negative axis.

Sweetcorn, peas, baked beans and tomatoes were strongly associated with being tinned, in contrast to those vegetables at the negative axis which were perceived to be grown outdoors and sold in plastic bags. The small vegetables were very well liked, with ten assessors' hedonic ratings associated with the positive axis of the first dimension. The popularity of these vegetables might in part be attributed to the 'child-friendly' convenience foods they were associated with: sausages, pies, fish-fingers, chicken nuggets, pizza and the ubiquitous chips (french fries). Baked beans on toast were another well-known combination, cited by six children. Another attribute frequently mentioned in connection with these four vegetables was the presence of a sauce, i.e. they either came in a sauce, or you ate them with sauce (most probably tomato ketchup).

GPA Group Average : dimension 1 (X axis) versus 2 (Y axis)

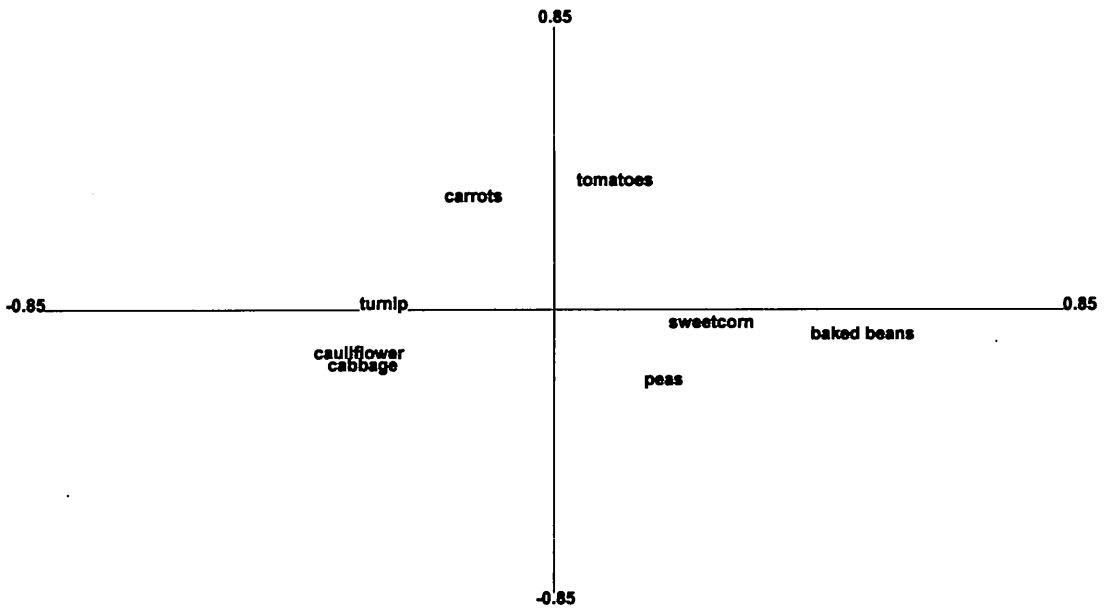


Figure 7.2: Dimension 1 (33%) and Dimension 2 (18%) of the sample consensus space.

The negative axis of Dimension 1 relates to the larger vegetables: cauliflower, cabbage, turnip and carrots. These four vegetables were not popular with the children, with no child's hedonic rating being significantly correlated with this axis, and three children perceiving them to be "yucky" (horrible). The assessors regarded these vegetables to be the ones served with "special meals" (e.g. Sunday lunch, Christmas dinner), and they required more preparation than the 'processed' vegetables in the form of peeling them. Cauliflower and the other 'big' vegetables were also thought of as "leafy", and they were hard and crunchy when eaten. Aside from eating them with special meals, these vegetables were served with meat, in salads and made into soup. Finally, the leafy vegetables were associated with being healthy by two of these children, both from the disadvantaged school.

Dimension 2 separates tomatoes and carrots at the positive axis from peas, cabbage, and cauliflower at the negative axis. Turnip, sweetcorn and baked beans cluster close to the origin. Dijksterhuis and Punter (1990) explain this as indicating poor consensus among assessors for those particular samples for this Dimension. These three samples also have

the lowest total variance (consensus) of all the vegetables for Dimension 2 (see Table 7.2) which supports Dijksterhuis and Punter's explanation.

The vegetables associated with the negative axis of Dimension 2 (peas, cabbage and cauliflower) were perceived overwhelmingly as being green vegetables, and to a slight degree as having leaves and being full of vitamins. Tomatoes and carrots at the opposite axis were described as containing pips (seeds), being juicy, and were eaten in sandwiches, in salads, raw, with meat and on their own. The hedonic scores of two of the assessors correlated with this axis, whereas the vegetables/attributes at the negative end of the dimension were not associated with the children's preferences.

Table 7.2: Residual and total (consensus) variance for Dimensions 1 to 4 distributed across the samples.

	Dim 1		Dim 2		Dim 3		Dim 4	
	Resid	Total	Resid	Total	Resid	Total	Resid	Total
Baked beans	0.60	11.97	0.21	0.54	0.39	5.37	0.28	0.54
Carrots	0.45	1.22	0.29	4.77	0.23	0.55	0.44	5.61
Tomatoes	0.31	0.77	0.51	6.44	0.36	1.70	0.39	4.52
Cauliflower	0.32	4.78	0.27	1.18	0.24	0.72	0.24	0.51
Turnip	0.48	3.99	0.35	0.35	0.26	0.96	0.41	0.45
Cabbage	0.31	4.74	0.27	1.68	0.20	0.30	0.30	0.66
Sweetcorn	0.55	3.55	0.17	0.29	0.35	1.19	0.17	0.91
Peas	0.49	1.88	0.29	2.50	0.25	3.99	0.22	0.74

Note: Resid = residual variance

Dimension 3 (15% of the total variance) and Dimension 4 (14% variance) of the sample space are shown in Figure 7.3. Associated with the positive axis of the third dimension are tomatoes, sweetcorn and peas. The children perceived this group of vegetables to be salad vegetables, and to grow on farms from plants. These vegetables are found in packets in the shops, and are eaten with fish and chips, in sandwiches (tomatoes) and with potatoes. Surprisingly, the children perceived these vegetables as being/tasting green, but actually peas have the strongest correlation with this axis (i.e. the highest GPA group average for this axis). The children liked the properties associated with the peas, sweetcorn and tomatoes with four of their hedonic scores correlated with this axis.

The negative axis of Dimension 3 has baked beans, turnip, cauliflower and carrots associated with it, with the latter three vegetables being closer to the origin (i.e. poor agreement over the children’s perceptions of these samples). Effectively it is baked beans that are described by the attributes strongly correlated with the negative axis, i.e. they come in a sauce, they are eaten with pies, on toast and with sausages, chicken nuggets and chips. Baked beans and their attributes associated with this axis of Dimension 3 are well liked by the assessors.

GPA Group Average : dimension 3 (X axis) versus 4 (Y axis)

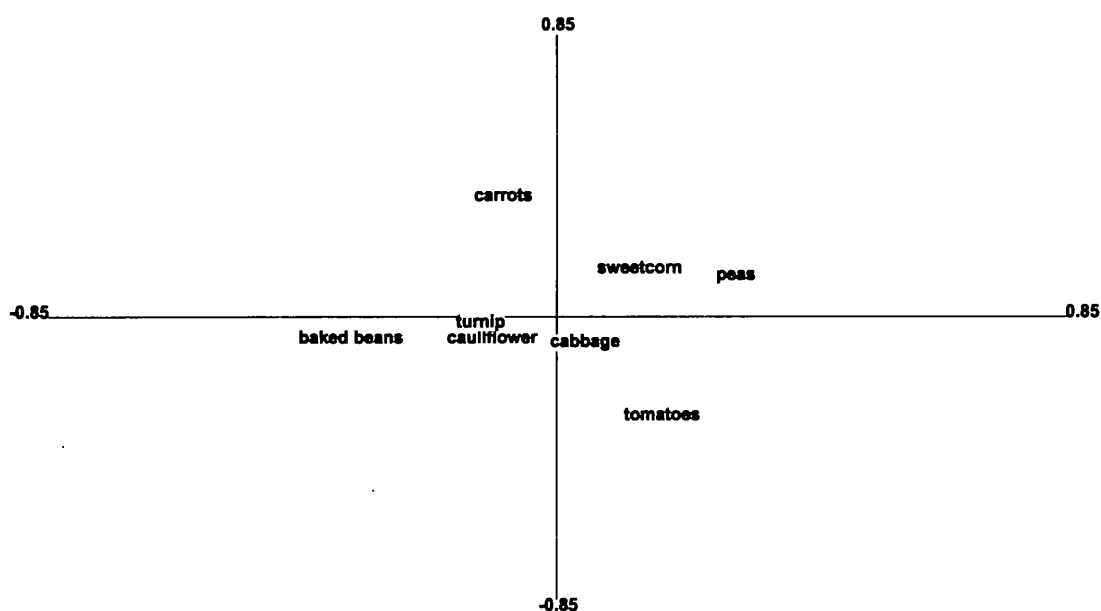


Figure 7.3: Dimension 3 (15%) and Dimension 4 (14%) of the sample consensus space.

Carrots, sweetcorn and peas are associated with the positive end of the fourth dimension. The perceptions of these vegetables that correlated with this axis mostly relate to the foods they are eaten with (mince and potatoes, fish and chips, chicken, and potato). Additionally, this axis is associated with vegetables that are crunchy and well liked (eight assessors' hedonic scores correlated with this axis). Carrots were also identified as "helping you to see in the dark", a veiled reference to the vitamin A content of these vegetables. At the negative axis of Dimension 4, tomatoes were the only vegetable with a strong association. The children whose attributes correlated with this axis of the fourth dimension perceived tomatoes as having seeds, and as being round, squishy (squashy), juicy and eaten in sandwiches.

7.3.2 Self-Reported Weekly Vegetable Consumption

All the assessors were asked to indicate how often they ate vegetables over the course of a week. The consumption data for five of the disadvantaged and three of the advantaged children were not provided. Pearson chi-square analysis of the self-reported frequency of

vegetable consumption showed highly significant ($p<0.001$) differences between the two socio-economic groups (Table 7.3). Twelve (60%) of the disadvantaged children ($n = 20$) reported eating vegetables less than four times a week, compared to just one advantaged assessors ($n=21$) who was in this ‘low vegetable consumer’ category. In contrast, 95% of the advantaged children were ‘high vegetable consumers’ (i.e. ate vegetables at least 4 times a week). Twelve (57%) of the advantaged children said that they ate vegetables every day, whilst only four (20%) of those from the disadvantaged area consumed vegetables on a daily basis.

Table 7.3: Chi-Square Analysis ($p<0.001$) of the Frequency of Weekly Vegetable Consumption by Socio-Economic Status

(SES 1 = advantaged; SES 7 = disadvantaged)

	Frequency of weekly vegetable consumption					
SCHOOL	never	once/week	2-3/week	4-6/week	Every day	Total
SES 1	0	0	1	8	12	21
SES 7	2	6	4	4	4	20
Total	2	6	5	12	16	41

Pearson’s chi-square also showed that the age of the children had a highly significant effect ($p<0.001$) on their self-reported vegetable consumption. Nine-year-olds (71% of the assessors) ate vegetables most frequently, while ten-year-olds (10% of assessors) ate vegetables least often. The children’s consumption was also significantly ($p<0.05$) influenced by gender with 74% of girls eating vegetables at least four times a week compared to 63% of boys.

7.3.3 Analysis of the Preference Scores

Hedonic scores for the eight sample vegetables were provided by all the assessors whilst scoring their personal constructs. To minimise any bias due to the nature of previous questions, the order of the hedonic scale on the scoresheet was randomised across the

assessors (Earthy *et al.*, 1997). Senpak v 2.0 (RSSL, Reading, UK) was used to construct the internal preference map of the hedonic scores for the assessors generated from the data of 39 of the 42 assessors. One assessor didn't complete his hedonic scale, while two others failed to discriminate between the samples.

Figure 7.4 shows Dimension 1(31% of the variance) and Dimension 2 (20% of the variance) of the internal preference map. The majority of the preference scores are located on the right-hand side of the preference map, indicating that the children's favourite vegetables are peas, sweetcorn and carrots. Baked beans were also popular with these Glaswegian children, with a number of assessors positioned close to this vegetable on the map.

Tomatoes, turnip, cauliflower and cabbage appear to be unpopular with these children, with very few of their preferences being associated with these samples. Interestingly, the assessors who gave these samples high preference scores are mainly disadvantaged. From the preference map (Figure 7.4) it is clear that the few children clustered around these vegetables are indeed pupils from the disadvantaged school.

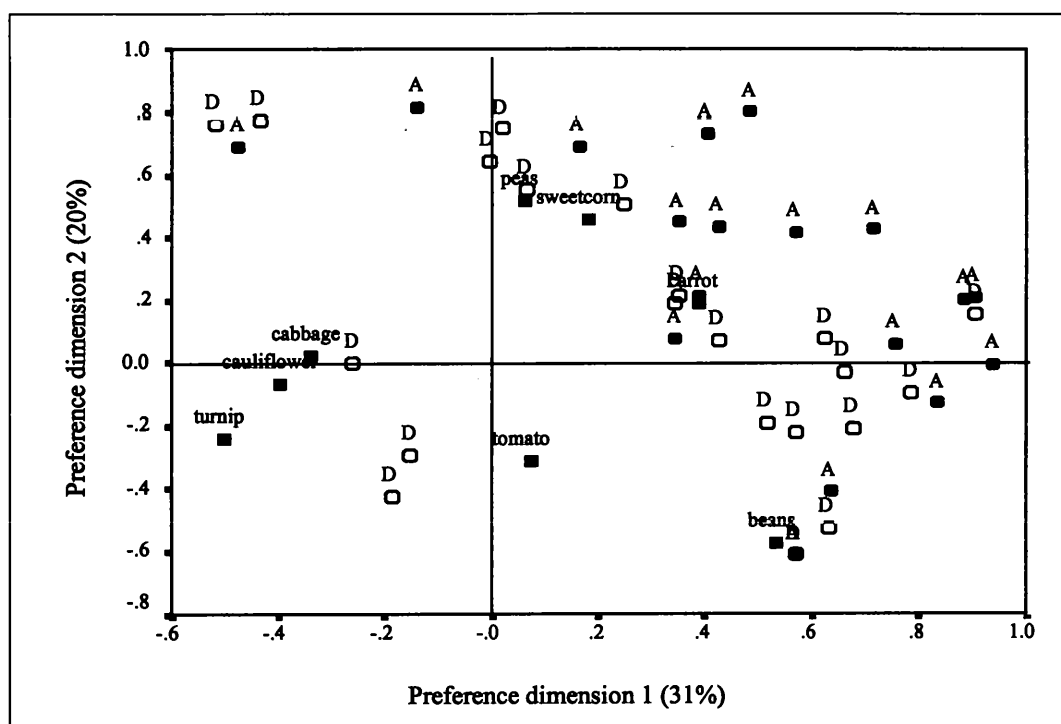


Figure 7.4: Internal analysis on vegetable hedonic scores of assessors who are significantly fitted on preference dimensions 1 and 2.

Assessors are labelled by socio-economic status (● = advantaged; ○ = disadvantaged).

Friedman's 2-way ANOVA showed that combined, the children's preferences for the vegetables were not equal ($p < 0.001$), with sweetcorn the most liked vegetable and turnip the least liked. The relatively large standard deviations for the preference scores illustrate how much variation there was between the children's preferences for each vegetable (Table 7.4).

The one-sample Kolmogorov-Smirnov test showed that the distribution of the preference scores were non-normal for four of the vegetables (baked beans, cabbage, sweetcorn and turnip). Non-parametric tests were therefore used to examine the influence of demographic variables on the hedonic scores. Mann-Whitney tests showed that neither

socio-economic status (Table 7.5) nor gender (Table 7.6) had a significant effect on the children’s preferences for the vegetables.

Table 7.4: Friedman two-way ANOVA results ($p<0.001$) from the Glasgow study.

Preferences were scored on 10cm linear scales where 0 = not like at all, 10 = like extremely.

Vegetable	Mean Preference Score	Std. Deviation	Mean Rank For Preference
Carrots	6.81	3.88	5.42
Sweetcorn	6.76	3.72	5.43
Baked beans	6.31	4.26	5.04
Peas	6.08	3.78	5.01
Tomatoes	4.63	4.24	4.13
Cabbage	3.81	3.92	3.68
Cauliflower	3.80	3.97	3.71
Turnip	3.32	3.80	3.57

Independent *t*-tests found that self-reported frequency of consumption significantly ($p<0.05$) related to the children’s overall vegetable preferences. The children that claimed to eat vegetables at least four times a week gave higher preference scores on average than those whom reportedly ate vegetables less often.

**Table 7.5: Mann-Whitney tests for the effect of socio-economic status
on preferences for the vegetables**
(where 0 = not like at all, 10 = like extremely).

Vegetables	SES	N	Mean Preference	Mean rank	p- value
Baked Beans	SES1	22	6.81	23.05	0.384
	SES7	20	5.71	19.80	
Cabbage	SES1	22	3.60	22.50	0.565
	SES7	20	3.43	20.40	
Carrots	SES1	22	7.70	23.57	0.235
	SES7	20	6.25	19.23	
Cauliflower	SES1	22	3.58	21.20	0.867
	SES7	20	4.36	21.83	
Peas	SES1	22	7.14	24.32	0.110
	SES7	20	5.08	18.40	
Sweetcorn	SES1	22	7.28	21.39	0.948
	SES7	20	6.91	21.63	
Tomatoes	SES1	22	4.59	19.64	0.294
	SES7	20	5.44	23.55	
Turnip	SES1	22	1.79	19.34	0.209
	SES7	20	3.55	23.88	

**Table 7.6: Mann-Whitney tests for the effect of gender
on preferences for the vegetables**

(where 0 = not like at all, 10 = like extremely).

Vegetables	Gender	N	Mean Preference	Mean rank	<i>p</i>- value
Baked Beans	M	23	6.62	23.22	0.310
	F	19	5.88	19.42	
Cabbage	M	23	2.86	18.74	0.096
	F	19	4.31	24.84	
Carrots	M	23	7.28	23.11	0.333
	F	19	6.68	19.55	
Cauliflower	M	23	3.64	20.46	0.534
	F	19	4.32	22.76	
Peas	M	23	6.71	23.80	0.171
	F	19	5.48	18.71	
Sweetcorn	M	23	7.36	23.22	0.298
	F	19	6.80	19.42	
Tomatoes	M	23	4.77	21.41	0.959
	F	19	5.26	21.61	
Turnip	M	23	3.03	21.46	0.979
	F	19	2.13	21.55	

7.4 Discussion

7.4.1 Socio-economic Status

By examining the socio-economic status of those whose attributes correlated with each of the dimensions, similarities and differences between the Glasgow children's perceptions of the vegetables can be found. Regardless of socio-economic status, the eight samples were separated along Dimension 1 of the sample space by their size, textural properties, freshness, preparation required, and whether they were suited to eating with convenience foods or with 'special' meals.

Overall, the Glaswegian children perceived baked beans, sweetcorn, peas and tomatoes as being tinned, soft, small and juicy, and as suited to eating with chips and typical 'children's' foods (i.e. fish-fingers, sausages, pizza). Interestingly, a higher proportion of the advantaged children associated these four vegetables as being soft (75% of the respondents), and as either coming in a sauce or being eaten with sauce (77%). There is no obvious reason for this difference between the two socio-economic groups. The majority (71%) of children who perceived these vegetables as suitable for "eating with sausages" were advantaged assessors, but grouping together all of the 'children's convenience foods' (i.e. pies, fish-fingers, chips, sausages, pizza, chicken nuggets, potato waffles) showed that slightly more (57%) disadvantaged children cited these foods as suited to eating with those vegetables.

No food diaries were kept by the assessors, so it is purely speculative as to whether the disadvantaged children actually consumed more convenience foods than the advantaged children. In terms of preferences, seven of the advantaged children liked the properties associated with baked beans, sweetcorn, peas and tomatoes compared to only three of the disadvantaged children.

Cauliflower, turnip, cabbage and carrots were similarly perceived by children at both schools as being large and crunchy vegetables, which grow in gardens or fields

(equivalent to their being 'natural'). More of the advantaged children (86% of citations) perceived these vegetables as being crunchy, and all of the five children who also described them as being hard were advantaged. It therefore appears that the advantaged children were more conscious of the texture of the sample vegetables. None of the children from either school liked the attributes associated with these vegetables. In terms of perceptual differences, all four children who associated eating these vegetables (mainly carrots and cabbage) with salads were from the disadvantaged area of Glasgow. This is probably be due to the time of year in which the study took place, as the advantaged children were interviewed in the winter (November), and the disadvantaged during the summer (June).

Dimension 2 divides the vegetables into those that are green, leafy vegetables (peas, cabbage, cauliflower) which are full of vitamins, and those that are juicy, can be eaten raw, eaten on their own, and which also happen to be liked better (carrots, tomatoes). Two assessors mentioned vitamins in conjunction with the green vegetables, and both of these are advantaged assessors. Also, carrots are perceived to be able to "help you see in the dark" by two children on Dimension 4, both of whom are advantaged pupils. Due to the small number of assessors, this doesn't seem significant. However in the study with the Edinburgh children (Chapter 6), although the vegetables described as healthy / full of vitamins were different, it was once again the children from the advantaged school who mentioned the health benefits associated with consuming vegetables. The children at both schools in Glasgow had been taught about food and nutrition prior to this research taking place, whereas it is not known if the Edinburgh children had also studied this topic before the perceptual data was collected.

The assessors who perceived the carrots and tomatoes as "juicy" (Dimension 2, positive axis) were from the advantaged school, again suggesting a raised textural awareness of these children compared to the disadvantaged children. Along the positive axis of Dimension 3, it is the advantaged assessors who perceive tomatoes, sweetcorn and peas as "juicy," and the assessors who perceived the vegetables associated with the positive axis of Dimension 4 as "crunchy" were all advantaged. Socio-economic status has also

been shown to heighten textural awareness (as compared to flavour awareness) in adults (Szczesniak, 1971), whereby the higher the socio-economic status, the greater the number of textural responses the respondents gave.

Dimension 3 separated the vegetables which the children perceived to be suited to eating with fish and chips, salad or sandwiches (sweetcorn, peas, tomatoes) from baked beans which are eaten with convenience foods (i.e. pies, chicken nuggets, sausages, chips). Children from both socio-economic groups equally liked these four vegetables and their associated attributes. One point of interest is that 75% of the citations regarding convenience foods were from the advantaged children. As food frequency questionnaires were not used in this study, it isn't known whether or not the advantaged children actually ate more of these types of foods.

7.4.2 Frequency of Vegetable Consumption

The highly significant chi-square analysis of the self-reported consumption data (Table 7.3) clearly demonstrates that the advantaged children eat vegetables more often than the disadvantaged assessors do. Ten percent of the disadvantaged children said they never ate any vegetables, with 40% (n=8) eating vegetables less than twice per week. In contrast, none of the advantaged children ate vegetables less than two-or-three times each week. In fact 57% (n=12) of the advantaged children claimed to eat vegetables on a daily basis. However, the 1996 National Food Survey (MAFF, 1997) showed that families with the lowest incomes consumed the most vegetables, although the highest-income households do consume similar quantities, with middle-income households consuming the least. It has previously been suggested that over-reporting of household vegetable consumption occurs during the week surveyed for the National Food Survey (cited in Leather, 1992), with low-income groups reportedly showing the greatest increase over and above their usual food purchases. Typically the better-off households consume the most fresh vegetables with the richest 20% of the UK population eating 20% more than the poorest 20% (Leather, 1992), although there is no mention of the effect of socio-economic status on the consumption of tinned and frozen vegetables.

US studies have found that vegetable consumption is lowest among those of lower socio-economic status, in both children (Kirby *et al.*, 1995) and adults (Dittus *et al.*, 1995). US adults with the lowest income and lowest education levels were also found to perceive the greatest number of barriers to their fruit and vegetable consumption (Dittus *et al.*, 1995), thus explaining their lower consumption. Barriers included the price of fresh fruit and vegetables, family members' dislike of fruit and vegetables, and a dislike for the taste of fruit and vegetables; all factors that are likely to impact upon the attitudes towards fruit and vegetable of any children in the household. In Scotland, research revealed that 60% of the study population believed that they ate sufficient fruit and vegetables, despite consuming well below the recommended five portions a day, but just 22% found price to be a barrier to the consumption of vegetables (Anderson *et al.*, 1994b). This over-confidence in the healthiness of their current diet is a major barrier to dietary change and increased fruit and vegetable consumption among Scottish adults, and is probably translated into a pattern of poor dietary habits by Scottish children.

7.4.3 Gender and Frequency of Vegetable Consumption

In this study (unlike the Edinburgh study, Chapter 6), gender was also found to have a significant ($p < 0.05$) effect on self-reported frequency of consumption with girls eating vegetables more often than the boys did. As discussed in Chapter 6, other studies have also found females to claim to eat more vegetables and salads than males in the west of Scotland (Anderson *et al.*, 1994c) and in the UK as a whole (Hackett *et al.*, 1997). Girls have also been shown to be significantly more aware than boys of the health benefits of consuming vegetables (Lund *et al.*, 1990), and are subsequently believed to have positive attitudes towards them which might explain the differences observed in the results presented in this chapter.

In terms of consumption of specific vegetables, Hackett *et al.* (1997) found that boys ate baked beans significantly more often than girls, while Australian research with ten-year-olds (Worsley *et al.*, 1984a) found girls to prefer both baked beans and raw tomatoes more than boys did. As this present study did not ask the children how often they ate the sample vegetables, it is not known if there were gender differences in the frequency of

consumption of particular varieties which might have affected preferences as a result of exposure (Birch *et al.*, 1982). Contrary to Worsley's study, the Mann-Whitney tests (Table 7.6) showed that in this study of Glaswegian children, the boys rated baked beans, carrots, peas and sweetcorn higher for preference than the girls, although these differences were non-significant. The girls gave (non-significantly) higher preference scores to the cauliflower and cabbage than the boys, but their scores were still in the 'dislike' portion of the scale.

7.4.4 Age of Assessors

Age had a significant effect ($p < 0.001$) on the children's reported consumption of vegetables. Children aged nine years old (71% of the total children) ate vegetables more often than the other children, whilst ten year olds (9.5% of all children) ate vegetables least often.

7.4.5 Preferences

The hedonic scores (Table 7.4) clearly show that the children disliked some vegetables (cauliflower, cabbage, turnip and tomatoes), giving them average preference scores below 5 on a 10 cm scale anchored '0 = not like at all' to '10 = like extremely'. The preference map (Figure 7.4) confirms this with few of the children's scores clustering near these vegetables. An earlier study (Cathro *et al.*, 1995) also found that cabbage (and Brussels sprouts) were the least liked vegetables among children of a similar age. One theory that might explain children's dislike of cauliflower, cabbage and Brussels sprouts is the vegetables' dark-green colour and leafy appearance. Children are known to find some vegetables bitter (Gibson *et al.*, 1998) which may relate to the colour-flavour associations that they make. It has been hypothesised that green colours in plant foods (e.g. vegetables) can suggest unripeness (Maga, 1974), while a group of 8-10 year olds perceived dark green colours to represent foods that are less sweet than light green coloured foods (Lavin and Lawless, 1998). Walker *et al.* (1973) also found that children expected a pleasanter flavour from light coloured green vegetables compared to those that were dark green.

The preference map (Figure 7.4) and the hedonic scores by socio-economic status (Table 7.5) show that the Glasgow children's preferred vegetables were sweetcorn, carrots, peas and baked beans. Carrots are the UK's most commonly eaten vegetable (IGD, 1998) and frequent exposure to them is likely to influence their popularity with children. Research with English children of a similar age also found carrots and peas to be favourites, as well as sweetcorn for the older children (Cathro *et al.*, 1995). When the multiple retailer Safeway developed a range of mini fruit and vegetable snacks for children, they based them on the premise that children like foods that are brightly coloured and sweet tasting (IGD, 1998). The four most popular vegetables with the Glaswegian children in this study also fit these criteria, as well as being small (carrots when sliced) and suited to eating with convenience foods.

Socio-economic status did not significantly affect the preferences of the children for the sample vegetables, although the mean preferences (Table 7.5) do (non-significantly) differ. The advantaged children gave the highest score to carrots whereas these were second after sweetcorn for the disadvantaged group. Peas were the third most liked of the samples for the advantaged group (mean = 7.14), but came fifth (mean = 5.08) out of the eight vegetables for the lower socio-economic status children. Tomatoes were liked slightly more by the disadvantaged children, which was the opposite of ten-year-olds studied in Australia (Worsley *et al.*, 1984b). Cabbage, cauliflower and turnip received mean preference scores below the mid-way point on the scale for children from both areas in Glasgow, although the disadvantaged children liked cauliflower and turnip more than their advantaged peers. In an identical study conducted in Edinburgh (Chapter 6), the children's least favourite vegetables were also cauliflower, cabbage and turnip, while again the disadvantaged children liked them significantly more.

7.5 Conclusions

The results from this study would suggest that texture is an important attribute that influences children's preferences for vegetables, especially children of a higher socio-economic status. The size, and the colour of the vegetables also effects children's likes

and dislikes with small, brightly coloured vegetables being preferred to large, dark green (and leafy) varieties. Colour-flavour associations with plant foods and other foods may cause children to associate vegetables from the red and yellow spectrum with sweet tastes, while expecting dark green vegetables to be bitter. Actual consumption of vegetable of such colours would be likely to confirm this hypothesis. The context in which vegetables are served also seems to influence children's preferences, whereby the varieties that they associate with convenience foods are given higher preference scores than those that are served with "special (adult) meals".

Socio-economic background was shown to influence the children's perceptions and preferences of vegetables, while self-reported frequency of consumption was influenced significantly by the socio-economic status of the assessor, as well as their gender and age. Overall preferences for the vegetables were also influenced by the frequency with which the children typically consumed vegetables.

Note

A paper based on this chapter has been published:

Baxter, I.A., Schröder, M.J.A. and Bower, J.A. (2000). Children's perceptions of and preferences for vegetables in the West of Scotland: the role of demographic factors.

Journal of Sensory Studies, 15, 361-381.

CHAPTER EIGHT: THE ANALYSIS OF THE COMBINED DATA FROM THE FOUR SCHOOLS AND THE CONVERSION OF FREE-CHOICE DATA TO CONSENSUS DATA

8.1 Introduction

To enable general conclusions to be made about the factors that influence children's perceptions of vegetables and their ensuing preferences, the data from all four schools that participated in the main study were combined. GPA was performed using the data collected from ninety-one children during the RGM interviews and construct scoring sessions and Senpak v2.0 (RSSL, Reading, UK) was used for the preference mapping, again as for the earlier chapters.

8.2 Results

8.2.1 Results after Generalised Procrustes Analysis

Assessors generated between 6-23 attributes (mean of 15 attributes). The first five dimensions of the perceptual space account for 87% of the total variance between the samples. Assessors' descriptors having an absolute correlation of ≥ 0.65 with the first four dimensions of the samples space can be seen in Table 8.1.

Table 8.1: Assessors’ descriptors having an absolute correlation of ≥ 0.65 with the first four dimensions of the samples space resulting from GPA of the data.

Dimension 1 (31% variance)	Dimension 2 (18% variance)	Dimension 3 (15% variance)	Dimension 4 (15% variance)	Dimension 5 (8% variance)
Tinned (+32)	With salad (+18)	Green (+6)	Has pips (+16)	With haggis (+12)
In sauce (+25)	Has pips (+18)	With chips (+5)	With salad (+5)	Halloween lanterns(+5)
Soft (+23)	Juicy (+18)	Like (+4)	In sandwiches (+4)	Sweet (+4)
Like (+21)	Eat raw (+10)	Sweet (+4)	Like (+2)	
With chips (+20)	In sandwiches (+9)	Juicy (+4)		
With sausages (+16)	In soup (+6)	Chewy (+4)	Like (-9)	
Small (+16)	Sweet (+6)		With meat (-7)	
With toast (+12)	Like (+5)	Like (-7)	Crunchy (-5)	
Juicy (+11)		With sauce (-4)	With special meals (-5)	
Tasty (+11)	Eat hot (-4)	With potatoes (-4)	With potatoes (-5)	
With pies (+8)	Tasty (-3)		Tasty (-4)	
With fish-fingers (+8)	Like (-1)		With mince (-4)	
Eat cooked (+7)				
With meat (+7)				
Big (-22)				
Crunchy (-20)				
Hard (-14)				
Grows in the ground (-11)				
Eat with special meals (-6)				
Peel it (-6)				
Cut it up (-6)				
With salad (-6)				
With meat (-5)				
Like (-2)				

The assessor plot (Figure 8.1) is too crowded to clearly show any grouping of the assessors as influenced by demographic factors. Sets 1-23 are the Glasgow advantaged children; sets 24-43 are the Glasgow disadvantaged children; sets 44-68 are the

'convenience' foods versus 'proper' meals). From Figure 8.2 it is clear that baked beans, sweetcorn and peas are the samples associated with the positive axis of Dimension 1.

Referring to the attributes with strong correlations with each axis (Table 8.1) it is clear that these are the processed vegetables (i.e. tinned) that are small, soft and juicy, and are eaten with quick-to-cook children's convenience foods such as sausages, chips, pies, and fish-fingers (chicken nuggets were also often mentioned during the RGM construct elicitation, particularly by the Glasgow children). All these vegetables either come in a sauce (baked beans) or can be eaten with sauce. These vegetables and the properties associated with them are extremely popular with the children.

Cauliflower, cabbage, turnip and carrots associated with the negative axis of the first dimension are the big, hard, crunchy vegetables which tend to be eaten with more formal meals that involve meat. These vegetables were also more likely to be served to accompany special meals (e.g. Christmas dinner, Sunday dinner) than the other vegetables. In contrast to the samples associated with the positive axis, these four vegetables were thought of as naturally grown, either at home or on a farm. These vegetables combined with their associated properties were not popular with the children, as indicated by just two children having hedonic ratings strongly correlated with this axis.

GPA Group Average : dimension 1 (X axis) versus 2 (Y axis)

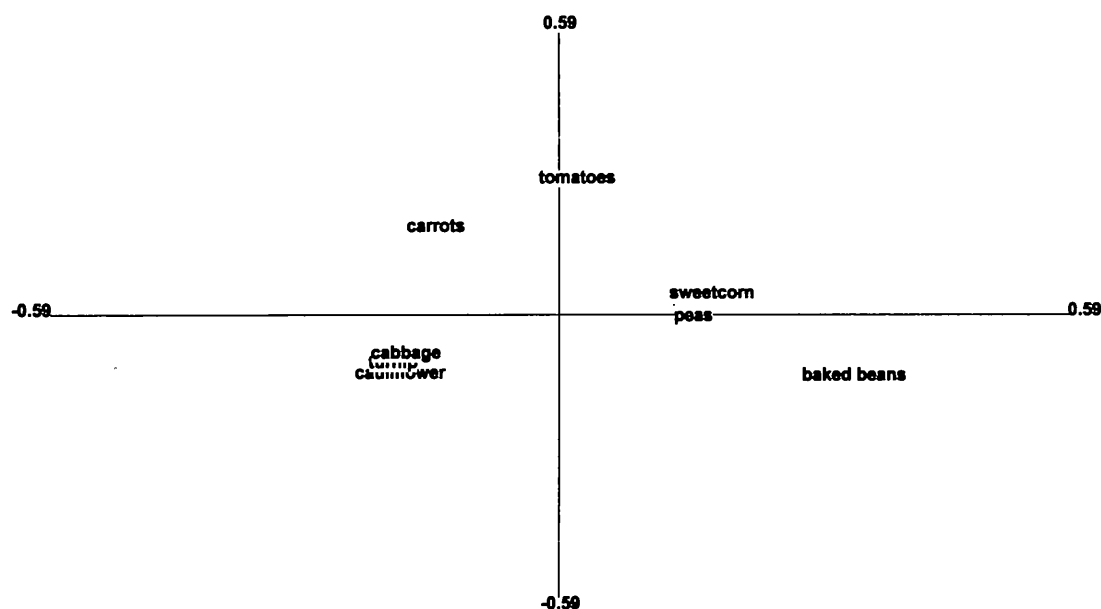


Figure 8.2: Dimension 1 (31%) and Dimension 2 (18%) of the sample consensus space based on the data from the children at all four participating Scottish schools.

Dimension 2 explains 15% of the total variance within the data. This dimension separates those vegetables that can be eaten raw/cold (tomatoes, carrots) from those that are eaten hot (baked beans, cauliflower, turnip, and cabbage). Tomatoes and carrots are associated with salads and sandwiches, but also with usage in soups. Juiciness was a property particularly attributed to tomatoes, as was the presence of pips, and both tomatoes and carrots were thought of as sweet. Five of the children's hedonic scores correlated strongly with this positive axis of the second dimension while just one child's scores were associated with the negative axis.

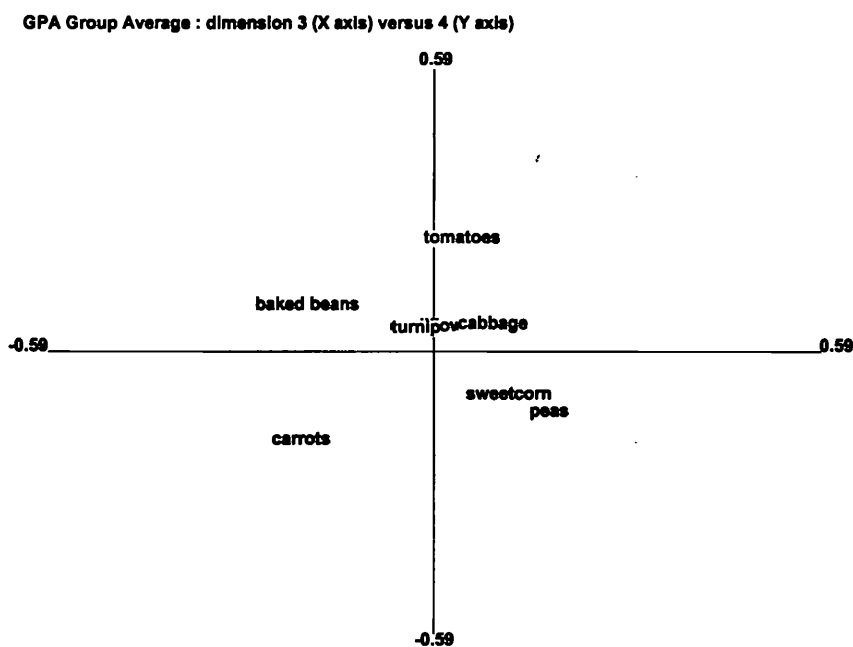


Figure 8.3: Dimension 3 (15%) and Dimension 4 (15%) of the consensus sample space.

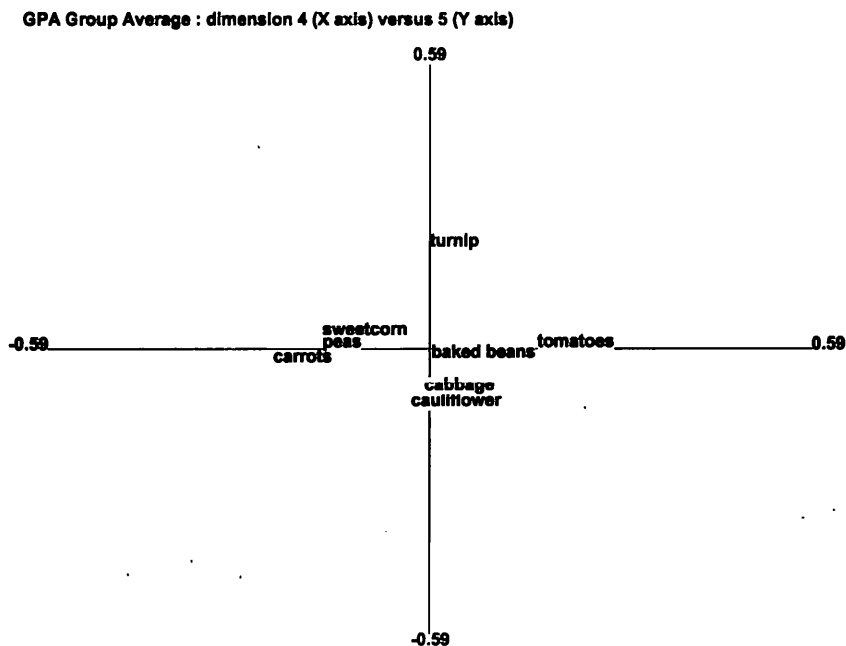
Dimension 3 of the sample space (Figure 8.3) doesn't add much to the explanation of how the children perceived the vegetables. Table 8.1 shows us that the vegetables associated with the positive axis (peas, sweetcorn, and to a lesser extent, cabbage) were liked by four assessors, and were green, eaten with chips, sweet and juicy. Baked beans and carrots were correlated with the negative axis of Dimension 3, and were regarded as suited to eating with potatoes, and associated with a sauce. The combination of these two vegetables with these attributes was liked by 7 of the 90 assessors.

The attributes associated with the positive axis of Dimension 4 (15% of the total variance) are attributed solely to tomatoes. The children predominantly mentioned the presence of pips in tomatoes, a characteristic which during the analysis of the Edinburgh data (Chapter 6) was found to be unappealing to the children. Tomatoes were associated with eating in salads and in sandwiches; qualities that made this sample a slight outlier in respect of the other sample vegetables. Along the negative axis of Dimension 4 we see

that, like the larger vegetables associated with the negative axis of the first dimension, peas, sweetcorn and carrots are also perceived to be suited to eating with meat and 'special' meals. However, the list of attributes in Table 8.1 suggests that, since these three are also associated with mince and potatoes, they are somehow slightly less formal than cauliflower, turnip and cabbage.

The fifth dimension of the sample space is included for discussion despite accounting for minimal variance (8%) within the data. This is because it uniquely describes turnip, a vegetable that was strongly associated with haggis by these Scottish schoolchildren. As already explained in Chapter 6, this is because 'haggis, tatties and neeps' (haggis, potatoes and turnip) are culturally identified as part of the traditional Burns' supper meal celebrating the birth of the Scottish poet. Additionally, but to a lesser degree, these children also allied turnip with Halloween, carving lanterns out of the turnip flesh. In terms of its sensory properties, turnip is found to be a sweet-tasting vegetable.

Figure 8.4: Dimension 4 (15%) and Dimension 5 (8%) of the consensus sample space.

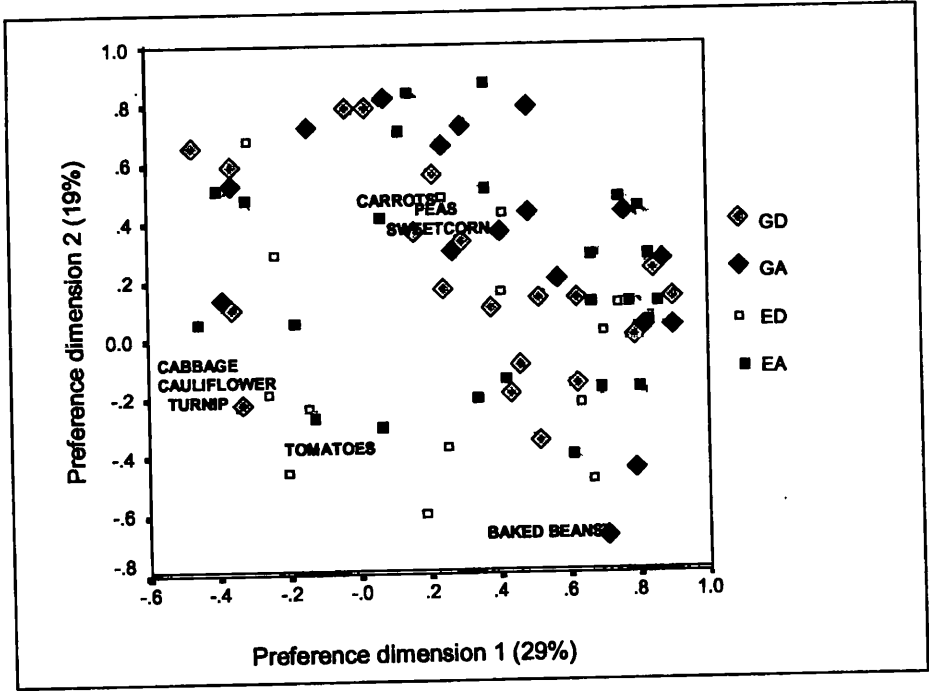


The sample plots for the first five dimensions (see Figures 8.2 to 8.4) for the data from the combined schools are essentially the same as those for the Edinburgh (Chapter Six) and Glasgow children (Chapter Seven) analysed separately. However, due to the larger number of assessors the hedonic data can be analysed to provide more powerful information regarding the children’s preferences.

8.2.2 Preference scores

The internal preference maps (Figures 8.5 and 8.6) for all children were constructed using the hedonic data from 86 of the 91 children. The scores of five assessors were not used in the analysis, as these children had not discriminated between the samples. Figure 8.5 shows the preference scores with assessors identified by SES and location, while Figure 8.6 shows the assessors identified by gender.

Figure 8.5: Internal analysis on vegetable acceptance scores of assessors who are significantly fitted on preference dimensions 1 and 2, separated by school.



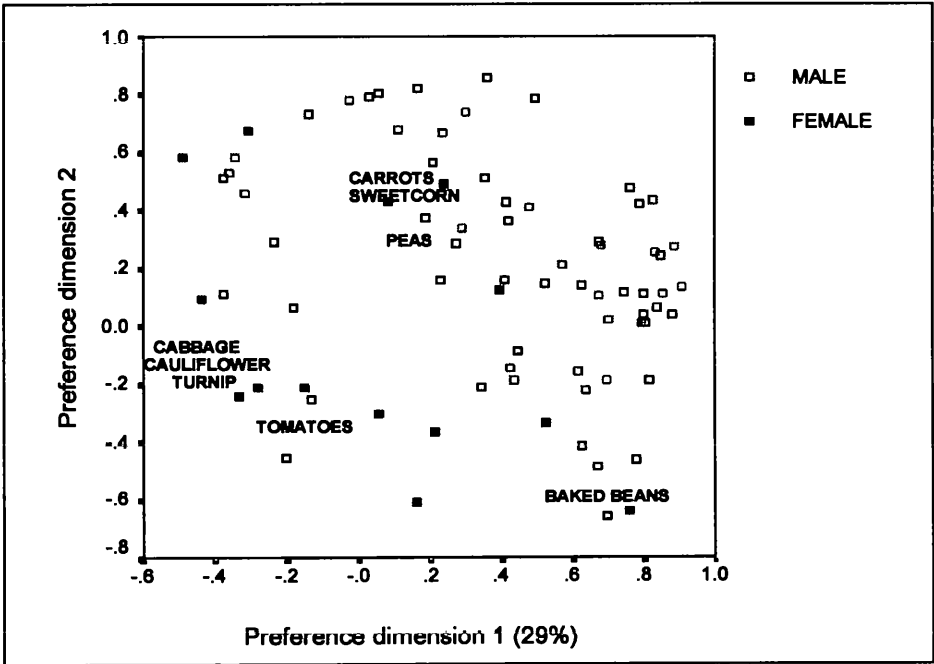
GA = Glasgow advantaged; GD = Glasgow disadvantaged; EA= Edinburgh advantaged; ED = Edinburgh disadvantaged.

From Figure 8.5 it can be seen that baked beans, peas, sweetcorn and carrots were the favourite vegetables while cauliflower, cabbage, tomato and turnip were unpopular (as

indicated by the lack of assessors clustered around these vegetables). Chi-square analysis showed that although there was no significant effect of the children's city of residence (i.e. Edinburgh or Glasgow) on their preference scores ($p=0.297$), their socio-economic status (SES) did have a significant influence ($p=0.049$). There were significantly more assessors of SES=1 ($n=30$) correlated with carrots, sweetcorn and peas (i.e. in the top, right-hand quadrant) than SES=7 assessors ($n=15$) showing that the advantaged children gave higher hedonic ratings to these three samples.

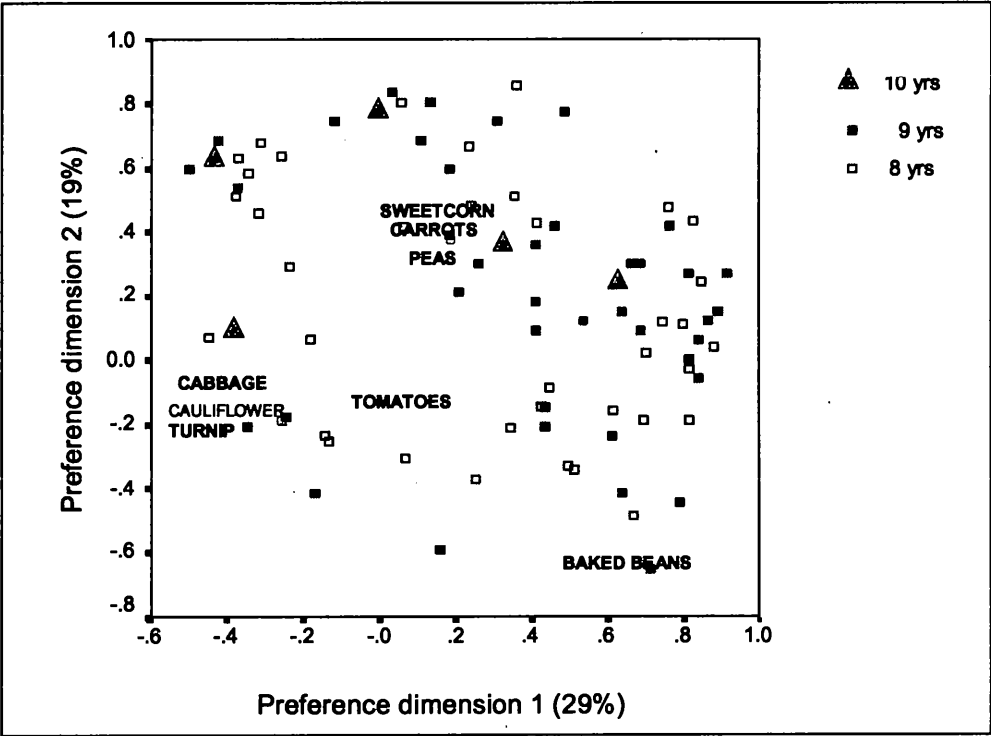
Of the 86 children whose hedonic data was used to construct the preference maps, 45 were female and 41 male. The preference map in Figure 8.6 shows the preference scores for the eight vegetables and the gender of the assessors. Chi-square analysis showed that there was no significant effect of gender ($p=0.271$) on the children's preferences.

Figure 8.6: Internal analysis on vegetable acceptance scores of assessors who are significantly fitted on preference dimensions 1 and 2, separated by gender.



The influence of the children’s age on their preference scores is shown in Figure 8.7. Chi-square analysis showed that age did not have a significant effect upon the children’s hedonic scores for the vegetables ($p=0.096$).

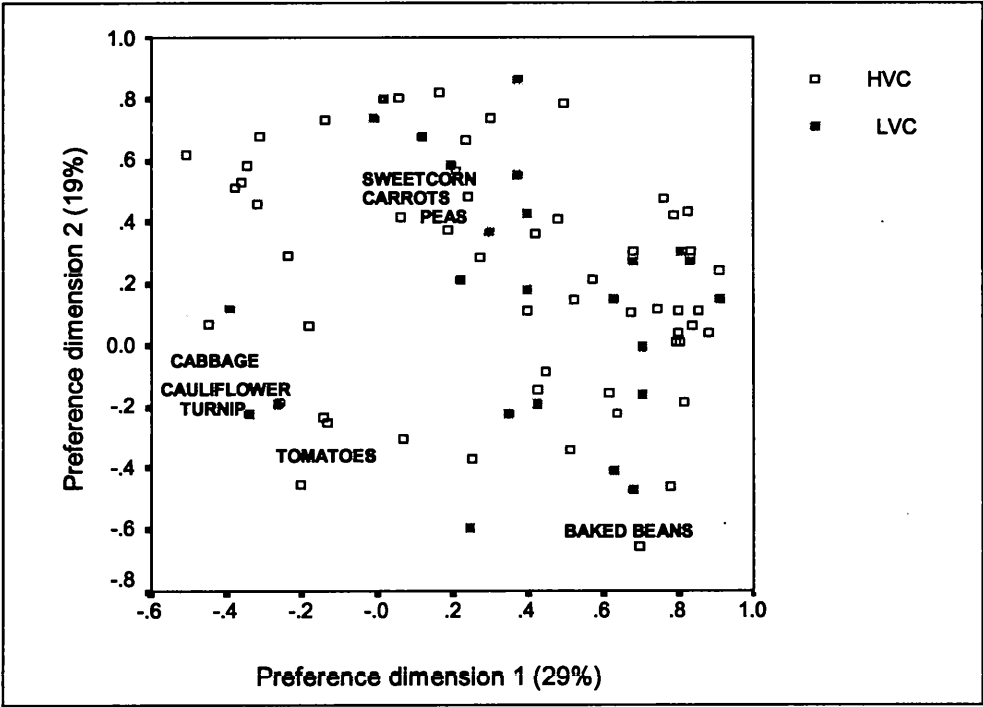
Figure 8.7: Internal analysis on vegetable acceptance scores of assessors who are significantly fitted on preference dimensions 1 and 2, separated by age.



The influence of the children’s self-reported vegetable consumption (weekly) is shown in Figure 8.8. High vegetable consumers are those who said they ate vegetables at least four-times per week, while the low vegetable consumers are those who said they ate vegetables less often than this. The data from 81 children were used to construct this preference map as five of the children had not indicated their typical weekly vegetable consumption. Chi-square analysis showed that there were no significant differences in the children’s hedonic scoring of the samples related to their frequency of vegetable

consumption ($p=0.335$).

Figure 8.8: Internal analysis on vegetable acceptance scores of assessors who are significantly fitted on preference dimensions 1 and 2, separated by self-reported frequency of weekly vegetable consumption.



Note: HVC = high vegetable consumer, consumes vegetables ≥ 4 times/week; LVC= low vegetable consumer, consumes vegetables < 4 times/week.

8.3 The Need for Further Data Analysis

No new information on the children’s perceptions of the vegetables was gained from the analysis of the combined data from the four participating schools as compared to that from the separate analysis by city (Chapters 6 and 7). GPA cannot be used to confidently conclude the influence of contextual variables upon the children’s perceptions of the sample vegetables. In previous chapters, the individual assessor correlations from GPA have been examined in detail and frequencies measured to assess the impact of the

assessors' demographic background (i.e. SES, age, and gender) on their perceptions of the vegetables (as shown by the GPA sample plots).

Internal preference mapping provides useful information on samples that are similarly liked. Inferences about the impact of contextual factors on preferences can be made by identifying the demographic background of assessors (as was done for Figures 8.5 to 8.8). However, it is not immediately apparent from the internal preference maps which sample attributes are driving the children's preferences, as it would be from an external preference map. External preference mapping is not possible without consensus data from external sensory panels (or alternatively, from instrumental analysis of the samples), so inferences about the properties of the vegetables that influenced the children's liking have so far been based on the GPA results and the internal preference map.

A statistical method of confidently analysing the impact of the demographic variables upon the children's perceptions of the vegetables was desired. Had the experimental data been consensus rather than free-choice data, data-reducing techniques such as principal components analysis (PCA) or correspondence analysis could have been employed. PCA would reduce the number of attributes used to a more manageable consensus set, which would afford an easier interpretation of the multidimensional perceptual space. Correspondence analysis (Hair *et al.*, 1995; McEwan and Schlich, 1991/92) could then have been employed to find correlations between the children's perceptions of the vegetables and the contextual variables (e.g. age, gender, frequency of vegetable consumption).

As the data was of a categorical nature and not all variables were measured as multiple nominal variables, non-linear principal components analysis was used to reduce the data set, rather than a classical PCA.

8.4 Non-linear Principal Components Analysis

PRINCALS is particularly suited to the data set discussed in this thesis because it can analyse variables that have different measurement levels – data that are nominal, ordinal, interval or ratio (SPSS Inc., 1994a). Such non-numerical variables are recoded to give them category quantifications (e.g. for gender; male = 1; female = 2). These category quantifications allow the non-numerical variables to be included in the principal components analysis.

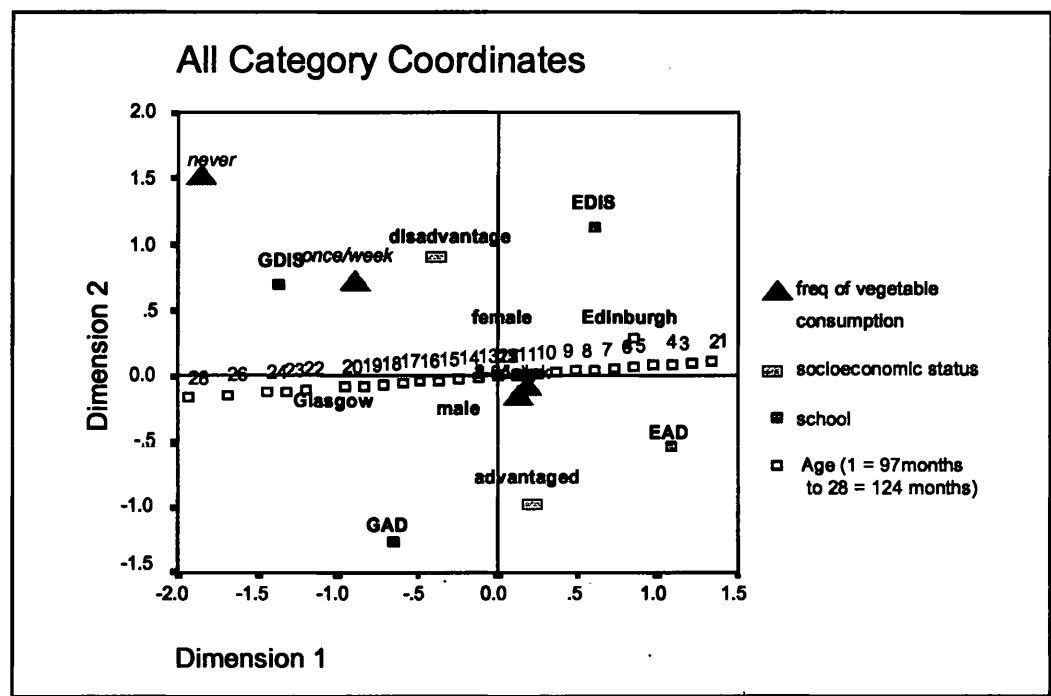
8.4.1 The Application of PRINCALS to the Demographic Data

Non-linear Principal Components Analysis (PRINCALS in SPSS v 7.5) was used to graphically show the relationship between the children's age, gender, school attended city of residence, SES, and frequency of vegetable consumption. The perceptual data could not be included for analysis by PRINCALS as the number of attributes and the attributes themselves were not constant for all assessors.

8.5 Results from PRINCALS

The categories co-ordinates plot (Figure 8.9) shows that not all the variables were separated by PRINCALS as clearly as would be expected if all the variables were truly ordinal (i.e. there are overlaps). The multiple points can be identified using the co-ordinates provided in Table 8.2. Three assessors (all from Glasgow) are positioned at the origin. There is also an overlap of the frequency with which assessors consume vegetables, and all those who eat vegetables at least twice a week are grouped together.

Figure 8.9: Category co-ordinates plot showing quantifications for all variables.



Note: For 'Schools', EDIS = Edinburgh disadvantaged, EAD = Edinburgh advantaged, GDIS = Glasgow disadvantaged, GAD = Glasgow advantaged.

From Figure 8.9 it can be seen that Dimension 1 (42% variance) separates the children according to the city in which they live and the frequency with which they consume vegetables. The Glaswegian children have a lower frequency of vegetable consumption compared to the Edinburgh children. The age of the assessors is accounted for along the first dimension; the children were younger in the Edinburgh schools than in the Glasgow schools. This would be explained by the organisation of the data collection stage, whereby the Edinburgh schools were surveyed before those in Glasgow.

Dimension 2 (36% variance) separates the children by socio-economic status, with the disadvantaged assessors associated with the positive axis and those who are advantaged at the negative axis. The advantaged assessors and the males allegedly ate vegetables

more often than the females. Children from the Glasgow disadvantaged school are positioned near to the ‘once a week’ vegetable consumption frequency, demonstrating a relationship between these two factors. Dimension 2 also separates the children according to gender.

Table 8.2: Summary of multiple points in Figure 8.10 allowing identification of the cases.

Dimension 1	Dimension 2	Label
.00	.00	Assessor 21
.00	.00	Assessor 25
.00	.00	Assessor 27
.16	-.13	2-3/week*
.16	-.13	4-6/week*
.16	-.13	Daily*

*Self-reported weekly vegetable consumption.

A third dimension was added (23% of the total variance) and the graph rotated using the 3-D rotation chart option available in SPSS v 7.5 (SPSS Inc., Chicago). This is not clear from a 2-dimensional view, so has not been reproduced here. The third dimension was seen to explain the effect of the age of the assessors and also reveals that the self-reported frequency of vegetable consumption was correlated to age. The younger the child is, the more frequently he/she eats vegetables. Possibly this is because younger children are more likely to be under parental control with regards to their dietary intakes (the difference in ages from the youngest to the oldest assessor is 28 months; from 8 years 1 month to 10 years 4 months).

PRINCALS allowed the correlations between the contextual variables to be clearly shown, but the children’s perceptual data cannot be explained in terms of these contextual factors using this method. To make strong inferences regarding the effect of the demographic background of the children and their perceptions and preferences, consensus data would be ideal, allowing the utilisation of methods such as principal components analysis (PCA).

8.6 Transforming ‘Free-Choice’ Data into Consensus Data

During the RGM construct elicitation stage, the 91 assessors had each generated their own personal vocabulary. Assessors used different descriptors, and a different number of descriptors from each other to describe their perceptions of the samples. Therefore, once the personal score-sheets had been completed, the data was essentially of a free-choice nature.

There are limitations regarding the analysis of free-choice data. While GPA is an ideal method for analysing this type of sensory data, the results do not readily allow the involvement of demographic factors to be accounted for. Conversely, PRINCALS illustrates inter-relationships between the demographic variables, but cannot account for the perceptual attributes. Another problem with the free-choice data was that the impact of the children’s perceptions of the vegetables on their preferences could not be reported with confidence, as external preference mapping requires consensus data, usually derived from a trained sensory panel.

It was therefore desirable to convert the data from all assessors into a consensus data set. The researcher could find no established procedure for the conversion of free-choice data to consensus data in the appropriate literature (Food Science and Technology Abstracts CD-ROM, April 1999).

8.6.1 Cluster Analysis to Aid Selection of the Consensus Attributes

The output from the GPA of the free-choice data (from the re-analysis of the original data excluding the hedonic scores) was examined, and for each child, the attributes with a loading $\geq \pm 0.70$ on the 1st dimension were selected. These were the attributes that explained the most variance within the GPA sample space. This new spreadsheet allowed the attributes to be ranked in order of their importance (i.e. according to the magnitude of the attribute loadings). It became apparent that the children were using different terms to describe what was likely to be the same perception, e.g. ‘mushy’, ‘squishy’, ‘squashy’

and 'soft' all seemed to mean 'soft'. A hierarchical cluster analysis of the attributes confirmed this, as well as clarifying further usage of similar descriptors.

On the basis of the cluster analysis, the researcher selected 13 'consensus' attributes. These are shown in Table 8.3, alongside the terms used by the children in a similar manner.

Assessors were only included in this new 'consensus' spreadsheet if their personal vocabulary contained at least seven out of the thirteen consensus attributes (i.e. over 50% of the new data set). Using this criterion, the data from 56 assessors (from a total of 91) were included. The original scale values for the samples for each child were selected. Mean values for each sample per attribute were calculated and substituted for missing values within the new consensus data set.

Table 8.3: Selected Consensus Attributes and Other Attributes Shown By Cluster Analysis to be Used in a Similar Manner by the Assessors.

Selected Attribute	Label Given (by researcher)	Other Attributes used in a Similar Manner by the Assessors
1.Soft	Soft	Soggy, mushy, squashy, squishy
2. Hard	Hard	Crunchy
3. Eat with meat at ‘formal’ meals	Meat	Special meals, Christmas dinner, Sunday dinner, roast dinner, with steak
4. Eat with children’s convenience foods	Convenience foods	With chips, sausages, egg, bacon, chicken nuggets, fish-fingers
5. Big	Big	Large
6. Small	Small	Tiny
7. Eat with/in sauce	Sauce	Tomato sauce, cheese sauce
8. Eat hot	Hot	Cook it
9. Eat cold	Cold	Eat raw
10. Contains seeds/pips	Seeds	No other attributes used
11. Comes in tins/packets	Packaging	Canned, plastic bags
12. Natural	Natural	Grows in ground, grows on farms, grows in gardens
13. Juicy	Juicy	Watery, refreshing

8.6.2 Principal Components Analysis of the Consensus Data

A Principal Components Analysis (PCA) of the consensus attributes was conducted using Senstools for Windows v 2.2 (OPandP and Talcott, Utrecht, The Netherlands).

Figure 8.10 shows the PCA plot for the new consensus data set. The first two principal components (PCs) explained 42% of the variance in the data. PC1 (28% variance) accounts for the sensory properties of the vegetables, with those that were perceived to be small and soft (baked beans, peas and sweetcorn) contrasting with those that were big and hard (cauliflower, turnip, cabbage and, to a lesser extent, tomatoes). PC1 also separated the vegetables according to their perceived naturalness (i.e. ‘packaging’ versus ‘grows naturally’). The ‘packaging’ attribute encompasses those vegetables (baked beans, peas

and sweetcorn) perceived as ‘manufactured’ (tinned, or frozen and bagged). The eating occasion with which the vegetables were associated were separated along PC1, with ‘with kids’ food’ (e.g. sausages, chicken nuggets, fish-fingers) having a high factor loading suggesting it had a significant influence on the variance within the data. The attribute ‘with meat’ (also representing ‘with special meals’, i.e. Christmas, Sunday lunch) has a much lower factor loading for PC1.

The vegetables are separated along PC2 according to the temperature at which they are eaten, their juiciness, the presence of a sauce (baked beans) and the presence of seeds (tomatoes). The presence of seeds, eating cold and growing naturally are attributes that are strongly associated with each other (as indicated by these attributes grouping closely together), and with tomatoes. The vegetables that are in/with a sauce are noted to be eaten hot. Figure 8.10 also reveals a negative correlation between the vegetables that are eaten hot and in a sauce, and the sensory property of juiciness.

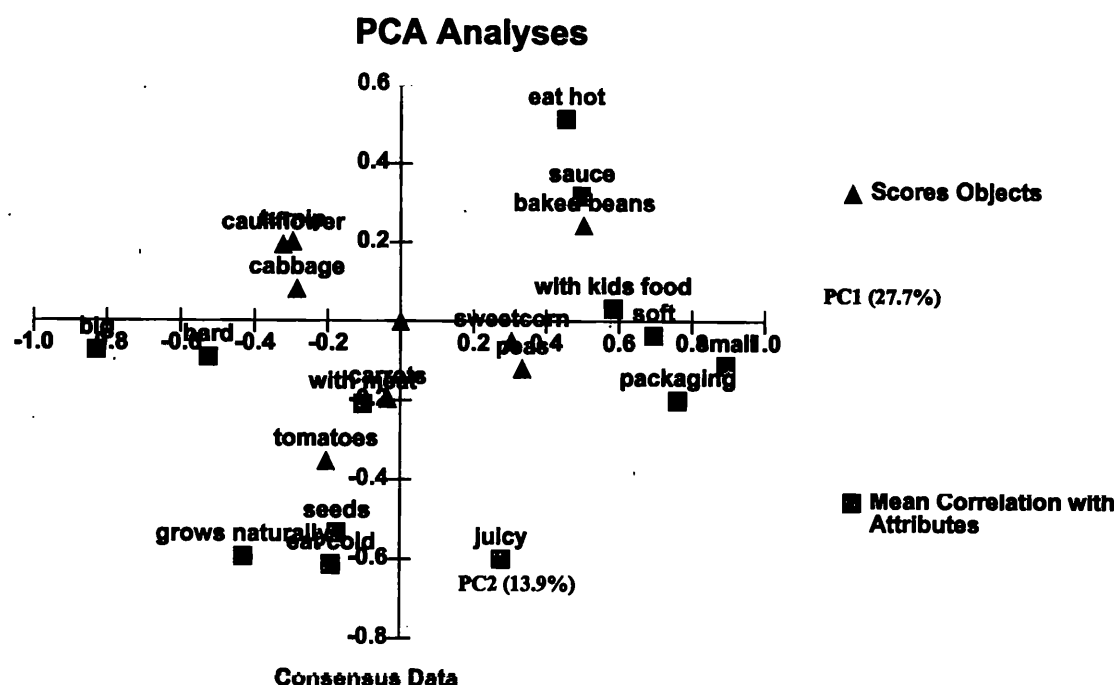


Figure 8.10: Principal Components Analysis Plot for the Consensus Data Set.

The results from PCA confirm those from the GPA earlier in this chapter, but also show the most influential sample attributes more clearly associated with particular vegetables.

8.7 Homogeneity analysis of the influence of contextual variables on the consensus attributes

8.7.1 Background

Homogeneity analysis by alternating least squares (HOMALS) is used with nominal data, and assigns values to the cases (objects) and the categories. Homogeneity analysis aims to separate the categories as much as possible, and objects in the same category are plotted close together, while objects in different categories are as distant from each other as possible (SPSS Inc.,1994b). HOMALS gives a similar result to correspondence analysis, but as opposed to correspondence analysis, HOMALS can be used when there are more than two variables (SPSS Inc., 1994b). Consensus data is required.

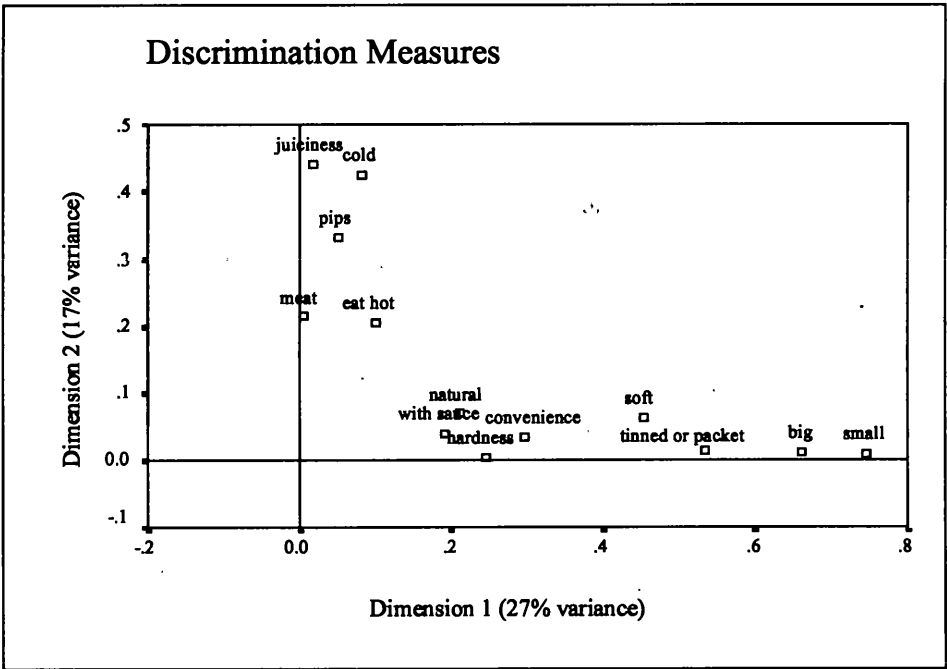
Prior to the HOMALS analysis being conducted, the consensus attributes were attributed the labels that would be used on the category quantification plots (typically 'high...' for scores ≥ 5 and 'low...' for scores < 5). HOMALS was then used on the consensus data (using SPSS v7.5, SPSS Inc., Chicago) to assess the influence of the contextual variables on the children's perceptions of the samples.

8.7.2 Results from Homogeneity Analysis

The plot of the discrimination measures (Figure 8.11) shows that the first dimension (27% variance) relates to the perceived naturalness of the vegetables (both 'natural' and 'tinned/packet' correlate with the 1st dimension), the size of the vegetables ('big' and 'small'), the hardness ('hard', 'soft'). Dimension 1 also relates to the vegetables which the children perceived to be suited to eating with convenience foods, and those that are in a sauce or eaten with sauce. Dimension 2 (17% variance) of the discrimination measures

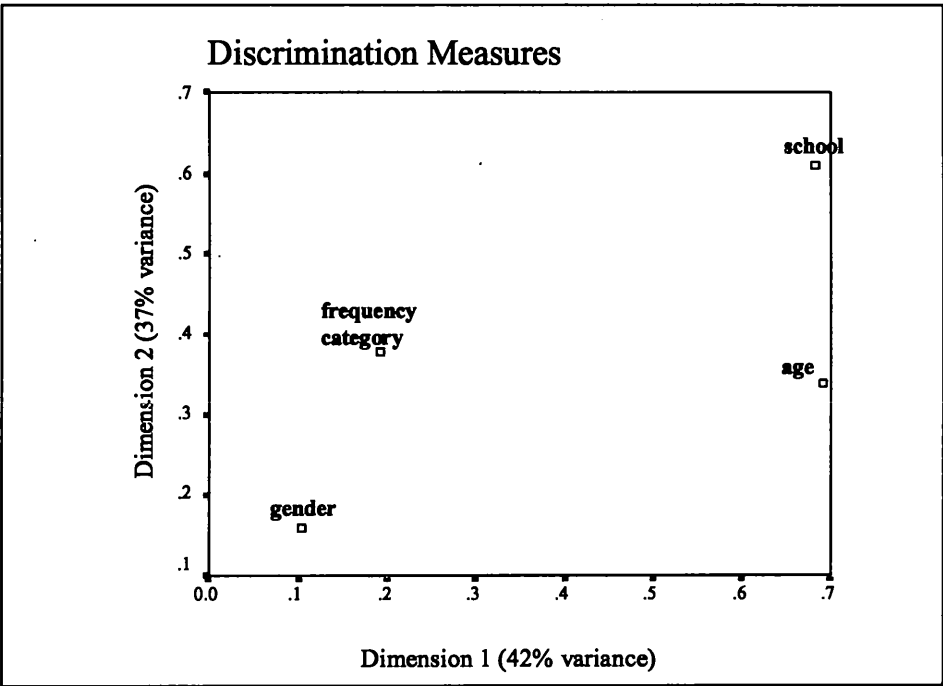
plot relates to the temperature at which the vegetables are eaten, the presence of pips, the perceived juiciness and those vegetables that are eaten with formal meals including meat.

Figure 8.11: Plot of the Discrimination Measures for the Consensus Attributes.



The relative influence of the contextual factors on the children’s perceptions of the samples is shown in Figure 8.12. The further from the origin, the more influential the factor is. Therefore gender can be seen to have the least effect, while the school (socio-economic status and city) and the age of the children have the greatest effect.

Figure 8.12: Plot of the Discrimination Measures for the Contextual Variables.

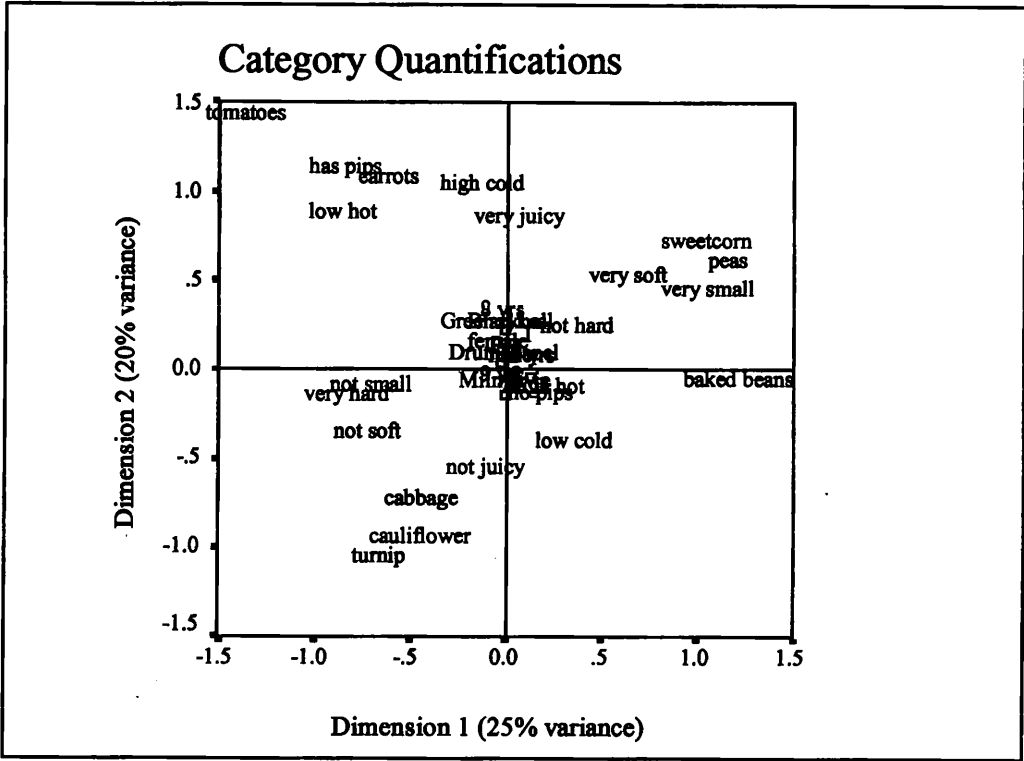


The HOMALS category plot of all the samples, consensus attributes and contextual variables from the thesis data was too crowded and consequently difficult to interpret. It was not possible to determine how much influence the contextual variables were having on the children’s perceptions. To overcome this problem, HOMALS was re-run, having selected just the ‘texture’ attributes (soft, hard, juicy, has pips, eat hot, eat cold), as shown in Figure 8.13.

The contextual variables (gender, age, frequency of vegetable consumption and school – encompassing both socio-economic status and city) are clustered close to the origin in Figure 8.13, demonstrating that they have less influence than the samples over the children’s scoring of the consensus attributes. It is evident from Figure 8.13 that the children understood the linear scales that were used to score their perceptions of the

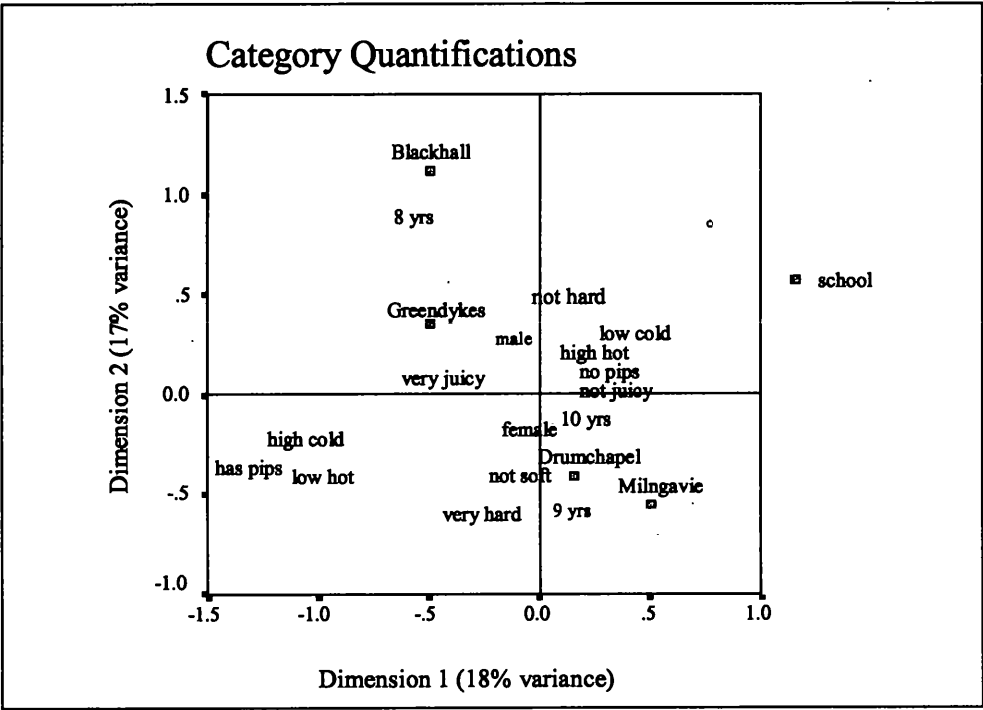
samples. This is demonstrated by the positioning of related attributes in close proximity to each other, such as ‘very soft’ near to ‘not hard’ and ‘high cold’ near to ‘low hot’.

Figure 8.13: Influence of Contextual Variables and Samples on the Children’s Perceptions of the Texture of the Vegetables.



Removing the samples from the analysis, the influence of the demographic variables on the children’s perceptions becomes clearer (Figure 8.14). Dimension 1 (explaining 19% of the variance) separates the children according to the city of residence (Blackhall and Greendykes being in Edinburgh; Milngavie and Drumchapel being in Glasgow), and age of assessor. Dimension 2 (17% variance) separates the assessors by gender and also by city of residence.

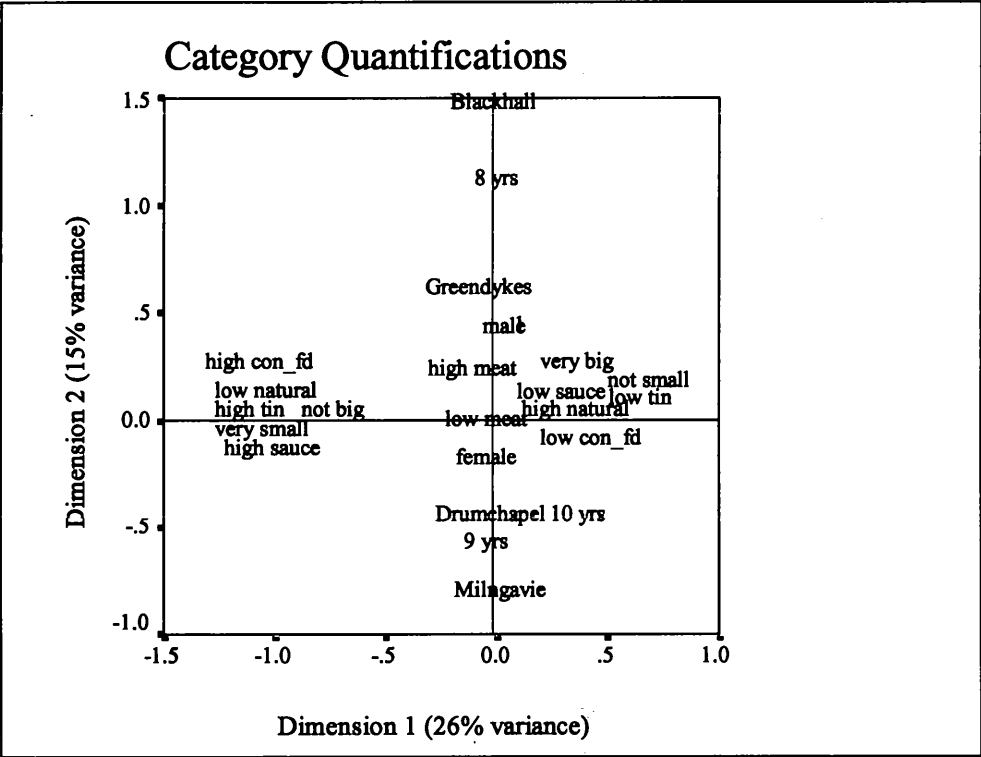
Figure 8.14: Influence of Contextual Variables on the Children’s Perceptions of the Texture of the Vegetables (excluding the samples from the analysis).



From Figure 8.14 it can be seen that Blackhall (Edinburgh advantaged school) is a greater distance away from Greendykes (Edinburgh disadvantaged) than Milngavie (Glasgow advantaged) is from Drumchapel (Glasgow disadvantaged). It is therefore clear that the socio-economic status of the children was more influential in Glasgow than in Edinburgh with regard to the children’s perceptions of the vegetables’ textural characteristics. The age of the assessor was also a strong influence on their perceptions of the vegetables as illustrated by the positioning of the age (in years) labels at a distance from the origin. Note that the positioning of the 9-year-olds coincides with Milngavie school so cannot be seen on the plot. It is also apparent that gender did have an effect on the children’s textural perceptions with the males being positioned close to the soft vegetables and apart from the females, who were close to the hard vegetables.

HOMALS was then used to analyse the other, non-textural consensus attributes. Again, the inclusion of the samples in the analysis made the category quantification plot too crowded to interpret. The vegetables were removed from the analysis and the results of the category quantification are shown in Figure 8.15 below.

Figure 8.15: Influence of Contextual Variables on the Children’s Perceptions of the Non-Textural Characteristics of the Vegetables (excluding the samples from the analysis).



The contextual variables are associated with Dimension 2 of the category quantification plot in Figure 8.15, while the perceptual attributes were correlated with Dimension 1. The socio-economic status of the children is more influential in Edinburgh than in Glasgow, as shown by the position of the Blackhall school (advantaged) a great distance from the Greendykes school (disadvantaged) in Figure 8.15. The gender had an influential effect on the children’s perceptions of the non-textural consensus attributes. The males were more strongly associated with the vegetables that were suited to eating with meat while

the females were associated with a low score for this attribute. The children who were low vegetable consumers (those who ate vegetables 0-3 times/week) scored the non-textural properties of the vegetables in the same way as the males (these labels are coincident points). The high vegetable consumers (those who ate vegetables ≥ 4 times/week) coincided with the position of the nine-year-olds and Drumchapel school, showing that these groups had the same perceptions of the non-textural properties of the vegetables.

The consensus attributes in are in two distinct clusters along Dimension 1 in Figure 8.15. The cluster memberships are detailed in Table 8.4.

Table 8.4: Membership of the Clusters of Non-Textural Consensus Attributes along Dimension 1 of Figure 8.15.

Attributes associated with the negative axis of Dimension 1	Attributes associated with the positive axis of Dimension 1
High ‘eat with convenience foods’	Low ‘eat with convenience foods’
Low ‘naturalness’	High ‘naturalness’
High ‘tinned/packet’	Low ‘tinned/packet’
High ‘presence of sauce’	Low ‘presence of sauce’
Very ‘small’	Low ‘small’
Not ‘big’	Very ‘big’

The attribute ‘eat with meat’ (pertaining to more formal meal occasions) was associated with Dimension 2 of the category quantification plot in Figure 8.15, and was influenced by gender of the assessors as already mentioned.

Overall the homogeneity analysis showed that the contextual variables, particularly the school and the age of the assessors, had some influence over the children’s perceptions of the vegetables based on the consensus attributes.

8.8 Multivariate analysis of variance of the contextual variables and consensus attributes

Multivariate analysis of variance (MANOVA) was performed on the consensus attributes with each of the contextual variables in turn. The school ($p\leq0.001$), socio-economic status ($p\leq0.005$), city ($p\leq0.005$), and the assessor’s age ($p\leq0.001$) were found to have a significant effect on the overall perception of the attributes. Gender and frequency of vegetable consumption were non-significant factors. Table 8.5 shows the attributes that were significantly influenced by particular contextual variables.

Table 8.5: Consensus Attributes Having Significant Interactions (from MANOVA) with the Contextual Variables.

<i>Attribute</i>	<i>School</i>	<i>SES</i>	<i>City</i>	<i>Age</i>
Soft	ns	ns	*	ns
Eat with meat	*	ns	ns	ns
Hard	ns	ns	ns	ns
Small	ns	ns	ns	ns
Eat in Sauce	*	*	*	**
Eat hot	ns	ns	ns	ns
Eat with convenience foods	*	*	*	ns
Eat cold	**	**	*	**
Has pips	ns	ns	ns	ns
Tinned/in packets	ns	ns	ns	ns
Big	ns	ns	ns	ns
Natural	ns	ns	ns	ns
Juicy	ns	ns	ns	ns

Note: * = $p\leq0.05$; ** = $p\leq0.005$; *** = $p\leq0.001$, ns – non significant

Of the attributes that show a significant effect due to one of the contextual factors, the interaction between socio-economic status and perceived suitability for eating with convenience foods is one of the most interesting. Having performed a one-way ANOVA test it was seen that the disadvantaged children were significantly ($p \leq0.05$) more likely than the advantaged children to perceive the vegetables as suited to eating with

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Soft	ns	ns	*	ns
Eat with meat	*	ns	ns	ns
Hard	ns	ns	ns	ns
Small	ns	ns	ns	ns
Eat in Sauce	*	*	*	**
Eat hot	ns	ns	ns	ns
Eat with convenience foods	*	*	*	ns
Eat cold	**	**	*	**
Has pips	ns	ns	ns	ns
Tinned/in packets	ns	ns	ns	ns
Big	ns	ns	ns	ns
Natural	ns	ns	ns	ns
Juicy	ns	ns	ns	ns

Note: * = $p\leq0.05$; ** = $p\leq0.005$; *** = $p\leq0.001$, ns – non significant

Of the attributes that show a significant effect due to one of the contextual factors, the interaction between socio-economic status and perceived suitability for eating with convenience foods is one of the most interesting. Having performed a one-way ANOVA test it was seen that the disadvantaged children were significantly ($p\leq0.05$) more likely than the advantaged children to perceive the vegetables as suited to eating with

convenience foods (such as chicken nuggets, fish-fingers, sausages). This suggests that the disadvantaged assessors ate convenience foods more often and so associated eating vegetables with them. The disadvantaged assessors also gave significantly ($p \leq 0.05$) higher scores for the presence of a sauce (as associated with baked beans). Baked beans (along with sweetcorn and peas) were also associated with convenience foods using GPA and PCA.

The city of residence influenced ($p \leq 0.05$) the children's perceptions of the vegetables suited to eating with convenience foods. Children in Edinburgh were significantly more likely to perceive the vegetables as suited to eating with convenience foods, suggesting that they ate these types of meals and/or associated vegetables more frequently than the Glasgow residents.

Also, the school was found to have a significant interaction with perceived suitability for eating with meat. One-way ANOVA showed that the assessors from Blackhall school (Edinburgh advantaged) were significantly ($p \leq 0.05$) more likely to find the vegetables suited to eating with meat (i.e. formal meal occasions) than the Greendykes assessors (Edinburgh disadvantaged). This contrasts with the finding that the disadvantaged assessors were more likely to find the vegetables suited to eating with convenience foods.

8.9 Formation of an Extended Internal Preference Map Using the Consensus Data

The 'external' preference map shown in Figure 8.16 has not been constructed in the usual manner. Typically, external preference maps are constructed by taking the sensory profile of a product obtained using either an expert sensory panel or instrumental measures, and then mapping the preference scores of an external consumer panel onto these (MacFie and Hedderley, 1993; McEwan, 1996). To construct the extended internal preference map (McEwan *et al.*, 1998), as in Figure 8.16, an internal preference map was constructed (using Senpak v2.0, RSSL, Reading, UK) using the hedonic scores of all the assessors

(n=86) that had discriminated between the samples with regard to preference. The mean scores for each of the consensus attributes were then correlated (Pearson Correlations) with the first three preference dimensions using SPSS v 7.5. These correlation coefficients were used as the co-ordinates for the preference map, as described by MacFie and Hedderley (1993) and McEwan (1996). Table 8.6 shows the correlation coefficients (and significance levels) for each of the attributes with the first three preference dimensions.

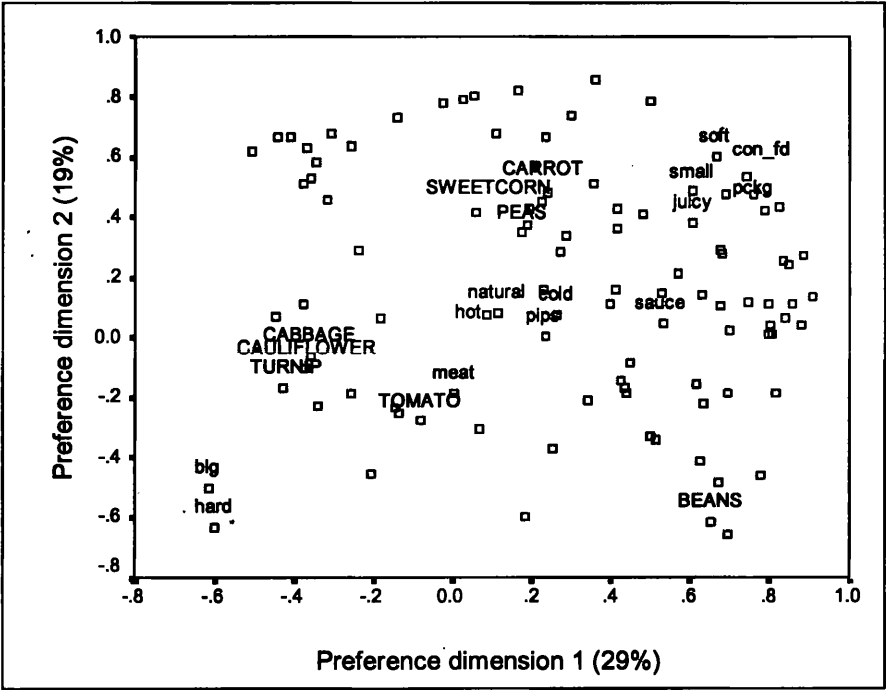
The positioning of the preference vectors in Figure 8.16 shows that the majority of the children preferred vegetables that are soft, small, juicy, packaged (i.e. tinned or frozen in plastic bags) and suited to eating with convenience foods (i.e. foods such as chicken nuggets, potato waffles, fish-fingers, sausages and chips). The children associated peas, carrots, sweetcorn and baked beans with these properties, and preferred these to the big, hard vegetables that they associated as an accompaniment to 'proper' meals containing meat (e.g. special meals, roast dinners, stews). Noticeably fewer children's preference scores were correlated with the latter vegetables (cabbage, turnip, and cauliflower). The position of tomatoes close to the origin of the multidimensional space shows that they have less influence on the preference map than the other vegetables. The PCA (Figure 8.10) had shown this was due to the presence of the pips, although this is not clear from the preference map.

Table 8.6: Pearson Correlation Coefficients for Consensus Attributes with the First Three Preference Dimensions.

Attribute	Correlation with PD1 (significance in brackets)	Correlation with PD2 (significance in brackets)	Correlation with PD3 (significance in brackets)
Big	-.616 (p=0.104)	-.501 (p=0.206)	.177 (p=0.679)
Eat cold	.264 (p=0.527)	.074 (p=0.861)	-.300 (p=0.470)
Convenience food	.742 (p=0.035)*	.538 (p=0.169)	-.322 (p=0.436)
Hard	-.599 (p=0.117)	-.634 (p=0.091)	-.088 (p=0.835)
Eat hot	.084 (p=0.843)	.076 (p=0.858)	.184 (p=0.663)
Juicy	.607 (p=0.110)	.379 (p=0.355)	-.480 (p=0.229)
Eat with meat	.001 (p=0.998)	-.187 (p=0.657)	-.851 (p=0.007)**
Natural	.116 (p=0.785)	.082 (p=0.846)	-.081 (p=0.848)
Has packaging	.690 (p=0.058)	.473 (p=0.236)	-.348 (p=0.398)
Has pips	.234 (p=0.576)	.004 (p=0.993)	-.390 (p=0.339)
In sauce	.531 (p=0.176)	.048 (p=0.910)	-.059 (p=0.891)
Small	.604 (p=0.113)	.485 (p=0.223)	-.332 (p=0.422)
Soft	.664 (p=0.073)	.602 (p=0.114)	-.142 (p=0.737)

*Note: * $p \leq 0.05$, ** $p \leq 0.01$, *** $p \leq 0.001$.*

Figure 8.16: Perceptual Attributes Projected onto the Internal Preference Map of Those Assessors Significantly Correlated with Preference Dimensions 1 and 2.



Note: 'pckg' = the presence of packaging (tinned/packets); 'con_fd' = convenience foods (e.g. chicken nuggets, potato waffles, sausages, chips).

8.9.1 Further Analysis of the Hedonic Scores

A Kolmogorov-Smirnov (K-S) test showed that the distribution of hedonic scores for each of the vegetables were non-parametric, with the K-S test statistic being significant ($p<0.05$) for each distribution (Diamantopoulos and Schlegelmilch, 1997, pp157-159). Therefore the Friedman 2-way ANOVA was used to find out if the children’s preferences for the samples were significantly different. The Friedman test is used with ordinal data where the samples are related (i.e the children scores the eight samples relative to each other, not independently) and provides a mean rank for each sample (shown in Table 8.7).

In this instance, the test statistic was highly significant ($p<0.0001$) showing that the children had distinctly different preference rankings for the eight vegetables.

The mean hedonic scores for each vegetable (Table 8.7) show carrots, sweetcorn, baked beans and peas to be the favourite vegetables which corresponds to the density of assessors clustered around these samples in the external preference map (Figure 8.16). Given that liking for the samples was scored on a scale where 0=not like at all, and 10=like extremely, it can be deduced that tomatoes, cabbage, cauliflower and turnip were disliked overall by the children (i.e. had hedonic scores less than 5).

Table 8.7: Results of Friedman Two-Way ANOVA ($p<0.001$) of Hedonic Scores for All Assessors.

Mean hedonic scores for the eight sample vegetables are shown, where 0 = 'not like at all', and 10= 'like extremely'. Standard deviations for the mean preferences are shown in brackets.

Vegetable	N	Mean Hedonic Score	Friedman Mean Rank for Hedonic Score
Carrots	91	6.81 (3.88)	5.42
Sweetcorn	91	6.76 (3.72)	5.43
Baked Beans	91	6.31 (4.26)	5.04
Peas	91	6.08 (3.78)	5.01
Tomatoes	91	4.63 (4.24)	4.13
Cabbage	91	3.81 (3.92)	3.68
Cauliflower	91	3.81 (3.97)	3.71
Turnip	91	3.32 (3.80)	3.57

To examine the influence of the contextual factors on the children’s preferences, Mann-Whitney tests were conducted. The results of these are shown in Tables 8.8 – 8.12. The children’s typical frequency of vegetable consumption was not found to have any significant effect upon their preferences for the vegetables.

Gender was found to have a significant (p 0.05) impact upon the assessors’ preferences for turnip (Table 8.9), with females having slightly higher preferences than males. The city of residence (Table 8.10) had no significant effect on the children’s hedonic scores. However, social status did have a significant effect on their liking for turnip (p 0.05), with the disadvantaged assessors liking turnip more (mean = 4.35) than those from advantaged backgrounds (mean = 2.30). The age of the assessor (Table 8.12) significantly influenced the children’s liking for turnip (p 0.01) with 8-year-olds giving this vegetable higher hedonic scores (mean = 4.06) than the 9-year-olds (mean = 2.42).

Table 8.8: Effect of Frequency of Vegetable Consumption on Preference:
Results of Mann-Whitney.

	¹ Freq.	N	Mean Liking	Mean Rank	Sig.
Beans	LVC	26	5.81	38.06	0.206
	HVC	59	6.68	45.18	
Cabbage	LVC	26	3.64	40.92	0.598
	HVC	59	3.88	43.92	
Carrots	LVC	26	6.15	38.38	0.239
	HVC	59	7.03	45.03	
Cauliflower	LVC	26	3.28	39.69	0.403
	HVC	59	3.99	44.46	
Peas	LVC	26	5.26	37.00	0.129
	HVC	59	6.59	45.64	
Sweetcorn	LVC	26	7.92	49.60	0.092
	HVC	59	6.24	40.09	
Tomatoes	LVC	26	5.19	47.00	0.314
	HVC	59	4.62	41.24	
Turnip	LVC	26	3.27	46.08	0.430
	HVC	59	2.95	41.64	

Note: ¹Freq = frequency of consumption where LVC = low vegetable consumers, i.e. ≤3 times/week and HVC = high vegetable consumers , i.e. ≥4 times/week.

Table 8.9: Effect of Gender on Preference: Results of Mann-Whitney Tests.

	Gender	N	Mean Liking	Mean Rank	¹ Sig.
Beans	Male	45	6.25	444.76	0.648
	Female	46	6.37	47.22	
Cabbage	Male	45	3.51	43.78	0.418
	Female	46	4.10	48.17	
Carrots	Male	45	6.94	46.60	0.826
	Female	46	6.68	45.41	
Cauliflower	Male	45	3.58	44.30	0.537
	Female	46	4.02	47.66	
Peas	Male	45	6.59	49.76	0.173
	Female	46	5.57	42.33	
Sweetcorn	Male	45	6.96	48.62	0.338
	Female	46	6.55	43.43	
Tomatoes	Male	45	4.29	43.81	0.428
	Female	46	4.97	48.14	
Turnip	Male	45	2.47	40.66	0.050*
	Female	46	4.14	51.23	

*Note: ¹Sig = Significance levels where * $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$.*

Table 8.10: Effect of City of Residence on Preference: Results of Mann-Whitney Tests.

	City	N	Mean Liking	Mean Rank	Sig.
Beans	Glasgow	42	6.29	44.92	0.710
	Edinburgh	49	6.33	46.93	
Cabbage	Glasgow	42	3.51	43.30	0.357
	Edinburgh	49	4.06	48.32	
Carrots	Glasgow	42	7.01	47.75	0.549
	Edinburgh	49	6.64	44.50	
Cauliflower	Glasgow	42	3.95	46.49	0.868
	Edinburgh	49	3.68	45.58	
Peas	Glasgow	42	6.16	46.74	0.802
	Edinburgh	49	6.01	45.37	
Sweetcorn	Glasgow	42	7.10	49.17	0.278
	Edinburgh	49	6.46	43.29	
Tomatoes	Glasgow	42	4.99	47.18	0.690
	Edinburgh	49	4.33	44.99	
Turnip	Glasgow	42	2.62	41.24	0.102
	Edinburgh	49	3.91	50.08	

Table 8.11: Effect of SES on Preference: Results of Mann-Whitney Tests.

	¹ SES	N	Mean liking	Mean Rank	² Sig.
Beans	SES 1	46	6.55	46.89	0.738
	SES 7	45	6.07	45.09	
Cabbage	SES 1	46	3.17	42.36	0.175
	SES 7	45	4.46	49.72	
Carrots	SES 1	46	7.38	49.01	0.260
	SES 7	45	6.24	42.92	
Cauliflower	SES 1	46	3.07	42.43	0.185
	SES 7	45	4.54	49.64	
Peas	SES 1	46	6.35	47.80	0.503
	SES 7	45	5.80	44.16	
Sweetcorn	SES 1	46	7.35	49.20	0.232
	SES 7	45	6.15	42.73	
Tomatoes	SES 1	46	5.06	47.87	0.489
	SES 7	45	4.20	44.09	
Turnip	SES 1	46	2.30	39.86	0.021*
	SES 7	45	4.35	52.28	

Note: ¹SES = socio-economic status, where SES 1 = advantaged; SES 7 = disadvantaged.

*²Sig = Significance levels where * $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$.*

Table 8.12: Effect of Age on Preference: Results of Mann-Whitney Tests.

	¹ Age	N	Mean Liking	Mean Rank	² Sig.
Beans	8 years	40	5.52	39.54	0.159
	9 years	46	7.25	46.95	
Cabbage	8 years	40	3.70	43.38	0.8965
	9 years	46	3.90	43.61	
Carrots	8 years	40	6.56	41.25	0.425
	9 years	46	7.02	45.46	
Cauliflower	8 years	40	3.88	44.25	0.792
	9 years	46	3.79	42.85	
Peas	8 years	40	6.05	42.10	0.622
	9 years	46	6.17	44.72	
Sweetcorn	8 years	40	6.58	42.99	0.856
	9 years	46	6.67	43.95	
Tomatoes	8 years	40	4.93	47.72	0.138
	9 years	46	4.17	39.83	
Turnip	8 years	40	4.06	50.76	0.010**
	9 years	46	2.42	37.18	

Note: ¹Age: 10 year olds were removed from the analysis as there were only 5 of them.

*²Sig = Significance levels where * $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$.*

8.10 Discussion

Internal preference mapping (Figures 8.5 to 8.8) showed that carrots, sweetcorn, peas and baked beans were the children's favourite vegetables while tomatoes, cauliflower, cabbage and turnip were not popular, receiving mean scores in the dislike portion of the hedonic scale. This can also be seen from Table 8.7, which displays the mean preference scores for the vegetables. However, the internal preference maps additionally show the effect of contextual variables on the children's preferences.

The socio-economic status of the children influenced their preferences with significantly ($p < 0.05$) more advantaged children correlated with carrots, peas and sweetcorn. None of the other contextual variables (age, gender, city, and frequency of vegetable consumption) significantly influenced the preference scores for the sample vegetables.

Referring back to the analysis of the data by city (Chapters 6 and 7), the overall vegetable preferences are very similar for both the Edinburgh analysis and that for the Glasgow data. It was therefore not surprising that the internal preference maps for the combined data set are not unduly influenced by the children's city of residence.

PRINCALS showed that the city and the socio-economic status of the area, i.e. the schools that they attended were the most influential contextual factors with regard to the children's weekly consumption of vegetables. The children from the Glasgow disadvantaged school ate vegetables less often than pupils from the other schools, while advantaged assessors were once more associated with higher frequencies of consumption. This probably relates to findings reported in the literature showing the disparity in vegetable consumption between Glasgow and Edinburgh (Tunstall-Pedoe *et al.*, 1989) and also between consumers of contrasting socio-economic status (Anderson *et al.*, 1994; Shepherd *et al.*, 1996; SOHHD, 1993; MAFF, 1996 and 1997).

The age of the children was influential towards self-reported consumption of vegetables as illustrated by PRINCALS, with younger children eating vegetables more frequently

than the older children. Possibly the parents of younger children have a greater control over their children's food consumption than they do once the children are older.

Surprisingly, PRINCALS showed that boys seemed to eat more vegetables than the girls, whereas in Chapter 7 it was shown that girls ate vegetables significantly more often than boys. Even if the girls were exaggerating their typical weekly consumption (it was self-reported) it would suggest that they are more aware of the benefits associated with vegetable consumption and therefore knew that they should be eating more than they did in reality. So girls might have been expected to have different perceptions of the vegetables than the boys. However, the suggestion from the PRINCALS data regarding the influence of gender on assessors' consumption is tenuous as little of the variance within the PRINCALS data was attributed to gender.

In this chapter it has been demonstrated that data of a free-choice nature can be converted with minimal loss of information into consensus data. The thirteen consensus attributes show the importance that the children ascribe to the texture (soft, hard, juicy, presence of seeds, temperature of serving), appearance (big, small), perceived suitability to meal occasions ('formal' meals with meat, children's convenience foods), and the perceived naturalness of the vegetables. These thirteen attributes were those that were most frequently mentioned by the 91 assessors, and that also significantly related to their perceptions of the sample vegetables (as demonstrated by the attributes high correlation coefficients with the dimensions of the GPA perceptual space).

The PCA of the consensus data showed that baked beans, sweetcorn and peas were associated with soft textures and with being small vegetables. These three vegetables were also strongly perceived as being packaged (i.e. tinned, frozen) and were eaten with the type of quick-to-cook foods popular with children (e.g. chicken nuggets, sausages, fish-fingers). Cauliflower, turnip and cabbage were the vegetables eaten with 'proper' meals which took more preparation and were often eaten on special occasions (Sunday dinner, celebratory meals). These three vegetables were also associated with being large, natural (unprocessed) vegetables and were thought to be hard compared to the other

samples. Tomatoes were associated with naturalness, eating cold, and the presence of seeds.

Homogeneity analysis (HOMALS) showed that the samples themselves were more responsible for the children's scoring of the vegetables than any of the contextual variables. However, removing the samples from the analysis, it became apparent that some variables had more influence than others. It must be borne in mind when considering the validity of these findings that the results are based on the data of just 56 assessors, i.e. those whose data was used to form the consensus data set.

The SES of the children was more influential with regard to the children's perceptions of the textural attributes among the Glasgow assessors than those residing in Edinburgh (Figure 8.14). Gender and frequency of vegetable consumption were seen to influence the children's perceptions of those vegetables suited to eating with meat (Figure 8.15). However, analysis by MANOVA found that gender and frequency of vegetable consumption had no significant effect on the children's scores for the consensus attributes.

Bearing this in mind, the relationship (by HOMALS) between gender and consumption frequency did suggest that males and low vegetable consumers were more likely to perceive the samples vegetables as being 'suitable for eating with meat' than did the females of high vegetable consumers. Perhaps the females and high vegetable consumers were used to eating vegetables with all main meals whether or not they contained meat. Other researchers (Hackett *et al.*, 1997; Anderson *et al.*, 1994b) have found that girls allegedly eat more vegetables than boys which would support this hypothesis with regard to gender.

In addition to illustrating links between perceptions and contextual variables, HOMALS also demonstrated that the children were proficient at using the linear scales to score the attributes.

Interestingly, analysis by MANOVA showed that the children's school, SES, city of residence and age all had significant effects (at different levels of significance) on their scores for the consensus attributes. Disadvantaged assessors were more likely to perceive the vegetables as suited to eating with convenience foods, possibly because they consume these types of meals more frequently than the children from advantaged households. The Edinburgh assessors also gave higher scores for 'eating with convenience foods' than the Glasgow children, while the Edinburgh advantaged children also scored the samples as highly suitable for eating with meat.

The consensus attributes were also used to construct an extended internal preference map to allow the influence of the children's perceptions of the vegetables upon their preferences to be clearly shown. The size of the vegetables, their texture and the meals they were served with helped to influence the children's preferences, with the small, soft and juicy vegetables that were associated with children's convenience foods (i.e. sweetcorn, peas, baked beans and carrots) the most liked. These vegetables were also associated with being packaged (i.e. tinned or frozen), whereas the attribute 'natural' was situated close to the origin, having little influence on the variance in the preference data.

Cauliflower, cabbage and turnip were grouped closely together with fewer children's preferences associated with these vegetables, indicating their unpopularity with most of the children. It seems that the children liked the smaller, softer, processed vegetables more than those that are larger, harder and more natural. Possibly it is the formality of the eating occasion associated with these vegetables which is causing the children's disliking for them as much as the sensory properties themselves. However the fact that the meals these were eaten with were often considered to be 'special' suggests that they occur infrequently. Considering that frequent exposure to foods is necessary to increase preference (Birch *et al.*, 1987; Birch and Marlin, 1982; Birch *et al.*, 1982) it is possible that the children do not eat these vegetables often enough (or with sufficient regularity), and so continue to dislike them.

Frequency of consumption of vegetables generically was found to be a significant influence on children's vegetable preferences in the Glasgow study (Chapter 7) which adds weight to this theory. Despite this, taking the data of all the children into consideration, Mann-Whitney tests showed that frequency of vegetable consumption (Table 8.8) had no significant effect upon the children's preference for any of the vegetables.

The presence of sauce can be seen to have a strong influence on the extended internal preference map. The children preferred vegetables such as baked beans that come in a sauce, or those that they eat with a sauce. Interestingly, there was anecdotal evidence from the pilot study that this influenced the vegetable preferences of children: *"Some vegetables I don't like are in stir-fry and they're much nicer in stir-fry because they've got sauce on them so you can't taste them"* (female, aged 9 years); *"I prefer vegetables all mixed up in food because with things like lasagne you get like pasta or a sauce"* (another female, aged 9). Cathro *et al.* (1995) also found that the most popular vegetable recipes they gave to LVC were those with sauces that masked the presence of the vegetables.

The presence of seeds ('pips') close to the origin of the preference map show that it does not strongly influence the children's vegetable preferences. However, conversely it can be suggested that the presence of pips is a contributing factor to the children's dislike of tomatoes.

According to the results of the Mann-Whitney (Tables 8.8 to 8.12), liking for turnip was significantly influenced by the gender, SES and age of the participating children. Girls also gave higher mean liking scores for baked beans, cabbage, cauliflower and tomatoes, but these differences were non-significant.

CHAPTER NINE: QUESTIONNAIRE ANALYSIS

9.1 Introduction

All the children who participated in the main study were given a questionnaire (See Appendix 3) to complete. Ideally, the children were to fill in the questionnaire themselves, however they were allowed to ask their teacher for help if required. Ninety-four questionnaires were given out to the children, of which 88 were returned. Of the 88, one had not been sufficiently completed to warrant inclusion in the analysis. Therefore, in total 87 completed questionnaires were analysed.

9.2 Designing the Questionnaire

As mentioned in Chapter 4, after conducting the pilot study at the Cambridgeshire school, it was decided that a questionnaire would be beneficial to gaining a further understanding of the factors that shaped children's vegetable perceptions and preferences. The pilot study (Chapter 5) had illustrated that children's exposure to vegetables influenced their knowledge and subsequent perceptions of the sample vegetables. Given the information in the appropriate literature (as discussed in Chapter 2), this was not at all surprising, but the experimental use of RGM did not allow this data to be recorded in any way.

A questionnaire was designed to examine the children's typical weekly vegetable consumption, their vegetable likes and dislikes (with reasons), the importance of the school meal to weekly vegetable consumption, the amount of control the children had over their own vegetable intake, and their familiarity with the sample vegetables. A decision was made not to record the children's daily vegetable intake because of anticipated problems with their comprehension of portion sizes. It was also expected that 8-year-old children would have difficulty averaging the number of times they ate vegetables on a daily rather than weekly basis. Food frequency questionnaires (FFQ)

were not used, as part of the appeal (to the children and teachers) of this research was thought to be the relatively short time required for the RGM/Questionnaire method. Also it has been documented in the literature that even adults have difficulty in completing FFQ accurately (Bingham, 1987) and there were concerns that the children might falsify the FFQ so as to complete the task quickly.

Finally, the questionnaire included a grid that would indicate on a five-point scale how well suited pairs of vegetables were for eating together. This was inspired by Drewnowski’s perceptual maps of compatible vegetables (Drewnowski, 1996) produced with US adults.

e. g. **Q. How suitable do you think the following pairs of vegetables are for eating together? Tick the appropriate box.**

	Very Suitable	Slightly Suitable	Not sure if suitable or unsuitable	Slightly unsuitable	Very unsuitable
Baked beans and Carrots	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Baked beans and Tomatoes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

9.3 Piloting the Questionnaire

Forty children aged between 7 years 0 months – 9 years 10 months (mean age 9 years 0 months) participated in the pilot of the questionnaire. Twenty-two of the children were female, 18 were male. The participants were children of the lecturers at Queen Margaret University College, and a class of pupils from an Edinburgh Primary School that had not been selected to participate in the main study. This school was purposely chosen to pilot the questionnaire as it is in an area of lower SES (DEPCAT 5). It was therefore hoped that the children's responses would assess the appropriateness of the questions for the disadvantaged groups in the main study.

At the back of the questionnaire there was a section for the children/parent to comment on the level of difficulty of the questions. The main comments received from the pilot children / parents were based on the grid in Question 10, assessing the suitability of eating the pairs of vegetables together. Some children thought that the vegetables were unsuitable for eating together if they didn't know of or like one of the pair. As it stood, the "Don't know" option for this question ("Not sure if suitable or unsuitable") was unclear. Otherwise, the questionnaire was found by the children to be easy to understand and complete.

9.4 Results from the Analysis of the Pilot Questionnaire

9.4.1 Self-Reported Frequency of Vegetable Consumption

The majority of the children from the pilot of the questionnaire ate vegetables every day (45%; n=18), although 33% of the respondents only ate vegetables once a week. During the piloting of the RGM part of the study (Chapter 5), it had become apparent that Sunday lunch was important for many of the children as the only time in which they ate any vegetables. This was not found to be the case when testing the questionnaire, as only 2 of the 13 (15%) 'once a week' respondents ate vegetables solely on Sundays.

Chi-square analysis of the results did not reveal any significant effects of age, gender, or socio-economic status on the children's frequency of vegetable consumption.

9.4.2 Vegetable Likes / Dislikes

Many of the children (45%) did not provide an answer to the question "Do you have a favourite vegetable?" It is probable that they either liked or disliked all vegetables equally, although which is not always clear from the responses.

Of those that did respond, the most common favourite vegetables were root vegetables (particularly carrots) or salad vegetables (e.g. tomatoes, cucumber, lettuce), each receiving 18% of the responses. The flavour of these vegetables was the most common reason (38% of responses) for the children's preferences. The lecturer's children were significantly ($p \leq 0.05$) more likely to prefer a root vegetable compared to the lower SES children.

Green vegetables (e.g. Brussels sprouts, cabbage, cauliflower) and salad vegetables (e.g. tomatoes) were the most disliked vegetables, each receiving 23% of the responses. Root vegetables (particularly turnip) were also often cited (18% of responses) as the most disliked vegetable. Again, the flavour was the influential factor that evoked the children's disliking for green vegetables (56% of those who disliked green vegetables said it was because of the flavour, and 22% said because of the smell), salad vegetables (56% said due to the flavour) and root vegetables (86% due to the flavour). However, as with all these results, as just 40 children were surveyed, the statistics are merely of interest rather than suggesting a trend.

9.4.3 The Importance of School Meals to Overall Vegetable Consumption

The vast majority (98%) of the children said that they ate vegetables at home, with 50% claiming to have some input in deciding which vegetables they ate. The age of the children did not significantly influence the control that they had over the vegetables they ate at home.

School dinners were eaten by 63% of the children, 56% of whom ate vegetables with their meal. A chi-square analysis of the results by socio-economic status showed that the lower socio-economic status children (DEPCAT 5) were significantly ($p \leq 0.005$) more likely to eat a school meal than the advantaged children, and that they were also significantly ($p \leq 0.05$) more likely to take vegetables with their school meal.

9.4.4 Familiarity with a Range of Vegetables

Questions 8 and 9 of the pilot questionnaire asked the children if they had tasted 11 vegetables (selected on the basis of common consumption on Scotland (MAFF, 1996), and including some of the original RGM sample vegetables). The results from these questions are summarised in Table 9.1 below.

Table 9.1: Familiarity of the children participating in the pilot questionnaire with eleven common vegetables.

	Have tried vegetable (%)	Know of vegetable (%)
Baked beans	93	100
Carrot	93	100
Tomato	80	95
Broccoli	73	95
Cauliflower	60	90
Peppers	70	95
Turnip	63	93
Celery	55	73
Lettuce	85	95
Peas	95	100
Cabbage	73	95

Relatively few of the children had tried celery, turnip, cauliflower or broccoli compared to the other vegetables. However, a few parents had commented that without a picture of the vegetable, there might have been confusion over the naming of turnip/swede, and possibly other vegetables also.

Chi-square analysis showed that the high vegetable consumers (i.e. ate vegetables more than 4 times/week) were more likely to have tried broccoli ($p \leq 0.005$), celery ($p \leq 0.01$), lettuce ($p \leq 0.05$) and cauliflower ($p \leq 0.01$). Perhaps this demonstrates that their greater exposure to vegetables (and subsequent familiarity) makes them less neophobic when it comes to new varieties of vegetables. Neither socio-economic group was more likely than the other to be high-vegetable consumers.

The older children (9-year-olds) appeared to be more adventurous in their tastes, and were significantly more likely to have tried peppers ($p \leq 0.001$), celery ($p \leq 0.05$) and tomatoes ($p \leq 0.05$) than the younger children. As children become older it is likely that they have had more frequent exposures to previously unfamiliar vegetables, and therefore (according to Birch and Marlin, 1982; Pliner, 1982) their preference for these vegetables is also likely to increase. It has been shown that just looking at a novel food can increase a child's willingness to try it (Pliner, 1982), and by the age of nine years it would be expected that the children were familiar at least with the sight of these three vegetables (i.e. peppers, celery and tomatoes).

9.5 Alterations to the Questionnaire Prior to the Main Study

As a result of the pilot to test the effectiveness of the questionnaire, some changes were made to the final questionnaire used (see Annexe 3). In Question 1, those children who only ate vegetables once a week were asked to indicate if this was on a particular day of the week, and if so which. They were then asked to give an explanation as to why they only ate vegetables on this day.

In Question 8 of the final questionnaire, the children were asked to indicate whether they have tried vegetables other than those used as the RGM samples. It was hoped that this would give an indication of the level of exposure to a variety of vegetables that the children with different demographic backgrounds received.

An additional question was inserted into the final questionnaire to assess whether or not the children actually liked the sample vegetables, giving reasons for their decisions. The children were also asked about the shops used by their family to purchase vegetables. It had been suggested (Anderson *et al.*, 1996) that in areas of social deprivation, the choice of vegetables was limited and lower SES consumers are denied the advantages of shopping in the multiple retailers (e.g. wider choice, quality produce, recipe ideas and discount prices due to bulk buying). This question (Question 12) aimed to further examine this issue.

One of the main changes to the questionnaire concerned the grid assessing the perceived suitability of pairs of vegetables for eating together. This question had been confusing for some of the pilot children, and the design involving all possible pairs of vegetables had made the questionnaire long and potentially off-putting. It was replaced with a shorter table in which the children were to indicate how suited the sample vegetables were to eating with particular meals. The chosen meals were based partly on those in an article in Health Education Research (Anderson *et al.*, 1994) along with other meals mentioned by children during the RGM pilot study. The scale for scoring appropriateness was simplified from a 5-point scale to what was effectively a 4-point scale:

- 0 = would be really horrible together
- 1 = would not be very nice together
- 2 = would be quite nice together
- 3 = would be really nice together
- DK = Don't know

9.6 Results from the Analysis of the Questionnaire from the Main Study

The results are based on the responses from 87 of the participating children of whom 44 were from Edinburgh schools and 43 from Glasgow schools. The respondents were almost equally split according to gender (53% male [n=46]) 47% female [n = 41]) and SES (53% DEPCAT 1; 47% DEPCAT 7).

9.6.1 Self-Reported Weekly Vegetable Consumption

Table 9.2 shows that the majority of the children ate vegetables between 4-6 times a week. Just two of the 87 children claimed that they never ate vegetables, and almost 30% ate vegetables every day.

Table 9.2: Self-reported frequency of vegetable consumption (weekly) among the main study participants

	Frequency of vegetable consumption (%)
Never	2.3% (n=2)
Once a week	10.3% (n=9)
2-3 times/ week	18.4% (n=16)
4-6 times/week	41.4% (n=36)
Every day	27.6% (n=24)

Of the nine assessors who reportedly ate vegetables only once a week, just three said that they ate vegetables on a specific day, and each ate them on a different day to the others. Therefore, Sunday lunch was not necessarily as important a source of vegetables for these children as it had been for those participating in the pilot RGM study.

Table 9.3: Effect of city of residence on self-reported frequency of vegetable consumption (weekly).

Frequency (weekly) vegetable consumption	Edinburgh	Glasgow	Sig.
< 4x week	13	13	0.944
> 4x week	31	30	

City of residence did not effect self-reported frequency of vegetable consumption (Table 9.3), with the majority of children from both cities claiming to eat vegetables at least 4 times a week. Chi-square analysis of the frequency of consumption by SES (Table 9.4) was also non significant.

Table 9.4: Effect of socio-economic status on self-reported weekly frequency of vegetable consumption.

SES 1 = advantaged; SES 7 = disadvantaged.

Frequency (weekly) vegetable consumption	SES 1	SES 7	Sig
< 4x week	10	16	0.079
> 4x week	36	25	

Gender also had no effect on frequency of vegetable consumption (Table 9.5) with the majority of both sexes claiming ot eat vegetables at least 4 times per week.

Table 9.5: Effect of gender on self-reported weekly frequency of vegetable consumption.

Frequency (weekly) vegetable consumption	Male	Female	Sig
< 4x week	16	10	0.290
> 4x week	30	31	

When analysing the effect of the children’s age on weekly vegetable consumption, ten-year-olds were removed from the analysis as there were just four of them and chi-square analysis requires each cell to have a count of at least 5. Age was not found to effect vegetable consumption between the 8-and-9-year-olds (Table 9.6).

Table 9.6: Effect of the assessors’ age on self-reported weekly frequency of vegetable consumption.

Frequency (weekly) vegetable consumption	8 years	9 years	Sig
< 4x week	11	12	0.925
> 4x week	28	32	

9.6.2 Vegetable Likes / Dislikes

Thirteen assessors (15%) did not have a favourite vegetable. Of those that did have a favourite, it was usually a root vegetable, as can be seen in Table 9.7. However, if the responses remain ‘un-classified’ by vegetable type, baked beans and carrots were the equal favourite vegetables (each with 26% of the responses).

Table 9.7: The vegetable preferences of primary-school children.

Vegetable Group	% of responses (n=87)
Root vegetables <i>e.g. carrot, turnip</i>	34.5
Small vegetables <i>e.g. sweetcorn, peas, baked beans</i>	25.3
Salad vegetables <i>e.g. cucumber, tomato, lettuce, celery</i>	11.5
Green vegetables <i>e.g. Brussel sprouts, cabbage, cauliflower, green beans, spinach</i>	10.3
Miscellaneous other vegetables <i>e.g. mushrooms, onions, aubergines</i>	3.4

The most common reason given by the children for their preferences of the vegetables was either the texture (33% of responses) or the flavour (32%). Table 9.8 shows the reasons given for their vegetable preferences.

Table 9.8: Reasons given by primary-school children for their vegetable preferences

Reason	% of responses (n=74)
Texture	32.9
Flavour	31.8
No reason given	12.6
“Nice”	11.5
Other non-sensory	5.7
“Don’t know”	2.3
Appearance	2.3
Smell	1.1

Among those children whose favourite vegetable was a root vegetable, the texture (57% of the responses, n=17) was overwhelmingly the most frequent reason given for this preference, followed by the flavour (27%, n=8). This was also the case with salad vegetables where 50% (n=5) of the children said their favourite was a salad vegetable

because of the texture (i.e. “crunchy” or “juicy”). This supports Szczesniak’s theory from the 1970s that children prefer vegetables with the texture associated with raw vegetables (Szczesniak, 1972), which was also found to be true of young children in a more recent UK study (Stead and Goodlad, 1996). Those children whose preferred vegetable was classified as ‘small’ liked these vegetables mainly because of their flavour (50%, n=11), as was also the case for those whose favourite was a green vegetable (44%, n=4).

Chi-square analysis showed no significant effect of age, socio-economic status, gender or city on the children’s favourite types of vegetables.

In terms of dislikes, the most commonly disliked vegetables were the leafy green vegetables and then root vegetables (Table 9.9). This is not too surprising given that this type of vegetables are commonly associated with bitter flavourants and as such are commonly disliked until children reach puberty and seem more willing to consume bitter foods (Baxter and Schröder, 1997). A study of 429 primary school children in the UK undertaken by Leatherhead Food RA (Cathro *et al.*, 1995) also found that children’s top two least favourite vegetables were leafy green vegetables.

Table 9.9: The least liked vegetable among primary-school children.

Vegetable group	% of responses (n=87)
Leafy green vegetables <i>e.g. Brussel sprouts, cabbage, cauliflower, spinach</i>	28.7
Root vegetables <i>e.g. carrot, turnip</i>	18.4
Small vegetables <i>e.g. sweetcorn, peas, baked beans</i>	17.2
Salad vegetables <i>e.g. cucumber, tomato, lettuce, celery</i>	14.9
Miscellaneous other vegetables <i>e.g. mushrooms, onions, aubergines</i>	6.9
Other green vegetables <i>e.g. green beans, courgettes</i>	3.4
Like all vegetables	6.9
Dislike all vegetables	1.1

Examining the disliked vegetables as single named vegetables rather than categorising them, the most commonly disliked vegetables among these children were cabbage (13.8%, n=12), tomatoes and baked beans (11.5%, n=10 each). Whereas the texture and flavour were equally responsible for the children's preferences, the flavour (41.7%, n=34) was by far the most common reason given for their dislike of the named vegetable, followed by the texture (15.5%, n=12) and the odour (9.5%, n=8) of that vegetable.

It was surprising that baked beans were quite unpopular as, along with carrots, they were also the children's favourite vegetable. Also, the internal preference maps (see Chapters 6 and 7) show baked beans to be well liked among these children. One explanation for this anomaly is that a larger number of children provided no answer to the question concerning their favourite vegetable (n=12) than for their least favourite vegetable (n=8) which may have skewed the results slightly.

Flavour was the main reason given (Table 9.10) for the children’s dislike of any vegetable (42% of responses), followed by texture (16% of responses).

Table 9.10: Reasons given by primary-school children for their vegetable dislikes.

Reason	% of responses (n=84)
Flavour	41.7
Texture	15.5
“Horrible”	11.9
Smell	9.5
Appearance	6.0
No answer	6.0
Non-sensory	4.8

Cabbage was mainly disliked because of its flavour (n=5 out of 12 responses) and smell (n=4). Tomatoes were disliked because of their texture (n=5 out of 10, mainly referring to the seeds), and baked beans were unpopular due to their taste (n=5 out of 10). Examining the reasons for disliking the vegetables classified by groups; leafy green vegetables were disliked because of their flavour (9 out of 16 responses), and salad vegetables were unpopular due to their texture (5 out of 13). With root vegetables (n=9 out of 16) and small vegetables (n=8 out of 15) it was the flavour that was mainly the reason for disliking them. The ‘other green vegetables’ were equally disliked due to their flavour and appearance (1 response out of 3 for each; the third child didn’t know why they disliked them).

Chi-square analysis showed no significant effect of age, gender, city, frequency of vegetable consumption, or socio-economic status on the types of vegetables that the children disliked.

9.6.3 Consumption of Vegetables at Home and at School

Overall, 85% (n=74) of the children ate vegetables at home. Of these seventy-four children, 84% said that an adult decided which vegetables they ate and 35% said that they

decided which they ate. In some families, both the adult and child decide, therefore explaining the discrepancy in the sum of the percentages.

Chi-square analysis showed that the children who were 'high vegetable consumers' (HVC; those who ate vegetables at least four times per week) were more likely ($p \leq 0.001$) to eat vegetables at home than the 'low vegetable consumers' (LVC; those who ate vegetables less than four times per week). The HVC were also more likely ($p \leq 0.05$) to have an adult choosing their vegetables for them than the LVC. The Edinburgh children were significantly ($p \leq 0.05$) more likely to be involved in choosing the vegetables that they ate than their Glasgow peers.

Sixty-six children (75%) ate a school meal, and 67% of these children said that they ate vegetables with their school dinner. The socio-economic status of the children did not significantly affect the uptake of school meals (as it had for the pilot questionnaire children), nor did the city in which the children live, their gender, nor their age. Whether or not the children ate vegetables with their school meal was unaffected by age, frequency of vegetable consumption, gender or socio-economic status. However, the city of residence did have an effect, with the children from Edinburgh significantly ($p \leq 0.05$) more likely to eat vegetables with their school meal than those from Glasgow.

9.6.4 Familiarity with the Sample Vegetables

As can be seen in Table 9.11, the majority of the assessors had previously tried the sample vegetables, or were at least familiar with them.

It should be noted that the children completed the questionnaires a few days after the RGM interviews, and the photographs of the samples were not used as prompts during the questionnaire completion. Also, Question 10 ("*Are there any of these vegetables that you are unfamiliar with?*") demonstrated the difficulty of ensuring that assessors understand the question, especially when working with children. The number of assessors who claimed not to know the sample vegetables does not tally (i.e. is larger) with the sum of those who had either not tried the vegetables or had not answered that part of the

question. Possibly Question 10 was not phrased clearly enough and caused some confusion.

Table 9.11: Previous exposure to and familiarity with the sample vegetables

Vegetable	% of assessors who have tried the vegetable	% of assessors who at least know of the vegetable	Number of assessors who did not know the vegetable (n=87)
Baked beans	93	93	4
Tomatoes	87	93	4
Carrots	94	92	5
Cauliflower	79	91	6
Turnip	79	91	6
Cabbage	86	92	5
Sweetcorn	93	94	3
Peas	94	92	5

Interestingly, the advantaged children were significantly less likely to have tried either cabbage ($p\leq0.05$) or cauliflower ($p\leq0.05$) as compared to the disadvantaged children.

Internal preference mapping of the assessors hedonic scores (from the construct score-sheets) had shown that the disadvantaged children liked cauliflower and cabbage more than the advantaged assessors in both the Edinburgh study (see Chapter 6 and Baxter *et al.*, 1999) and the Glasgow study (see Chapter 7). The fact that chi-square analysis of the questionnaires also revealed that the advantaged assessors were significantly less likely to have tried peas ($p\leq0.05$) than their disadvantaged peers cannot be so readily explained by the preference maps previously detailed in this thesis.

Question 9 had asked the children to indicate vegetables other than the sample ones that they had eaten. The majority (31%, n=27) did not name any other vegetables while 23% (n=20) named one other variety, 9% (n=8) named 3 others and 10% (n=9) named 5 other vegetables. One child each named 10, 11 or 15 other vegetables. All three children were advantaged assessors, but were not from the same school. A chi-square analysis of the

number of vegetables eaten (grouped as ‘ \leq five vegetables’ versus ‘ \geq six vegetables’) showed that the Glasgow assessors ate significantly ($p \leq 0.05$) more varieties of vegetables than the other children. The age of the assessor was also significant ($p \leq 0.05$) with 9-year-olds eating a greater number of ‘other vegetables’ than the 8- and 10-year-olds. Those children who ate vegetables more than 4 times a week (the HVC) were, not surprisingly, significantly ($p \leq 0.05$) more likely to have eaten more varieties of vegetables than the LVC. Cathro *et al.* (1995) had found that their HVC purchased a wider variety of vegetables compared to the LVC, who were hesitant to try new varieties of vegetables as they lacked preparation knowledge and worried that their families would not like other vegetables. Neither gender ($p=0.523$), nor SES ($p=0.064$) had any significant effect upon the number of other varieties of vegetables eaten by the children questioned for this thesis.

9.6.5 Liking of the Sample Vegetables

Question 11 asked the children if they liked each of the eight vegetables, and to provide reasons for their answers. Table 9.12 shows the proportion of the assessors who either liked or disliked each of the sample vegetables (the row totals do not sum to 100 as some children did not know if they liked the vegetables or not, and some did not respond).

Table 9.12: Children’s liking and disliking for the sample vegetables.

Vegetable	% Like (n=87)	% Don’t like (n=87)
Baked beans	67	29
Tomatoes	51	36
Carrots	72	18
Cauliflower	37	48
Turnip	35	47
Cabbage	39	45
Sweetcorn	71	20
Peas	58	31

Carrots and sweetcorn can be seen to be the most liked vegetables of those surveyed. Baked beans were also popular with these children (despite being the third most disliked in response to Question 3). Carrots were liked mainly due to their texture (41%), perhaps referring to the crunchiness of raw carrots, while their taste and texture were equally given (19%) as reasons for not liking them. The children particularly liked the flavour of sweetcorn (48%), although those that disliked this vegetable also did so because of its flavour (35%). The main reason given for liking baked beans was their taste (33%), which was also the main reason for disliking them (24%). Peas were liked by more than half of the children, particularly because of their flavour (32%), while their texture (22%) and flavour (19%) were given most often as reasons for disliking them. Tomatoes were liked because of their “sweet” flavour (25%) and their “juicy” texture (27%), while the texture (mainly the presence of pips) was off-putting for 32% of those who disliked this vegetable.

Cauliflower, cabbage and turnip were liked by less than half of the children, which agrees with results of preference mapping in Chapters 6 and 7. The flavour of these vegetables was the main reason for their unpopularity; 28% of those that disliked cabbage, 41% of those who disliked cauliflower, and 34% of those who disliked turnip cited the flavour as the reason. All three vegetables were also liked by some of the assessors, notably due to their textures, which were often mentioned as “crunchy”.

9.6.6 Shops Used by the Assessors’ Family to Purchase Vegetables

Question 12 was included in the questionnaire because it was apparent from local knowledge of the selected study schools (the author has lived in both Glasgow and Edinburgh) that the disadvantaged areas had a poor choice of shops in their local vicinity. Additionally, Anderson *et al.* (1996) and Leather (1992) had noted that supermarkets rarely locate in deprived areas and therefore residents of these areas are forced to shop in outlets where the choice of fresh fruit and vegetables is limited and those on offer are poor quality and of high price.

Table 9.13: Shops used by the families of the children to purchase vegetables

Generic type of shop	% family use type of shop (n=87)	% family do not use type of shop (n=87)
Supermarket	81	12
Greengrocer	25	68
Local corner shop	2	91
Other shops*	5	89

** It was not clear from the responses what other types of shops were being used.*

From the results of the questionnaire, it was apparent that the majority of the families (74%) used just one type of shop for the purchase of their vegetables, while just 20% of families used two types of shop. Table 9.13 shows that the supermarket is the most frequently used retail outlet for the purchase of the families' vegetables. Chi-square analysis clearly showed that the advantaged families were significantly more likely to use the supermarket ($p \leq 0.005$), and also the greengrocer ($p \leq 0.001$) than the disadvantaged families. The families residing in advantaged areas were also more likely ($p \leq 0.001$) to use more than one shop to purchase their vegetables, probably a good indication of the wider choice available to them. The disadvantaged families were significantly more likely to buy their vegetables from the local corner shop ($p \leq 0.01$) or from other (unspecified) shops ($p \leq 0.005$).

When visiting the schools involved in the project it was strikingly obvious that the advantaged areas had a wider choice of shops selling superior quality produce. In the Edinburgh advantaged area (Blackhall) there is a large supermarket offering a wide choice of fresh produce including organic vegetables, and close to the school were a range of high-street shops including two greengrocers.

In the disadvantaged area of Edinburgh, the nearest shop within walking distance of the school was a corner shop offering soft carrots and mouldy cauliflower for sale as its 'fresh' selection of vegetables, although it did have frozen and canned available. The nearest supermarket was Iceland (the frozen food retailers), so again fresh vegetables were not readily available to the residents of the Greendykes area. There was a similar

situation in Drumchapel (the Glasgow disadvantaged area), with a local shop on the estate and a mobile van; neither of which sold fresh vegetables. The author did not explore outside the near vicinity of the school, so it was not apparent where fresh vegetables could be purchased. In Milngavie (Glasgow advantaged area) there was a range of small high-street greengrocers and a large supermarket close to the school from which a wide range of fresh vegetables could be purchased. These observations help to explain the significant differences in the shopping habits of children of differing socio-economic status.

9.6.7 Suitability of sample vegetables for eating with commonly available foods

The final part of the questionnaire asked the children to indicate how well suited each of the eight vegetables was for eating as an accompaniment to (or in) nine different foods/meals. Tables 9.14 to 9.21 show the perceived suitability of each vegetable and the results of Pearson’s chi-square analysis to test for significant differences in suitability between the vegetables.

Table 9.14: Suitability of the sample vegetables for eating with a ‘fry-up’ (i.e. any combination of fried sausage, bacon, egg & chips).

	With a ‘fry-up’			Sig.
	Do not go together	Go together	Not sure	
Cauliflower	51	13	23	<i>p</i> 0.001
Carrots	38	25	24	
Baked beans	22	44	21	
Sweetcorn	38	25	24	
Tomatoes	38	20	29	
Turnip	50	9	28	
Cabbage	49	13	25	
Peas	34	27	26	

Baked beans were perceived as definitely suited to eating with a fry-up, while there is ambivalence as to whether or not some of the other vegetables are suited. However, cauliflower, cabbage and turnip were thought to be definitely unsuitable.

Table 9.15: Suitability of the sample vegetables for eating with burgers

	With burgers			Sig.
	Do not go together	Go together	Not sure	
Cauliflower	56	11	20	<i>p</i> 0.001
Carrots	48	17	22	
Baked beans	33	31	23	
Sweetcorn	36	27	24	
Tomatoes	39	26	22	
Turnip	52	8	27	
Cabbage	49	14	24	
Peas	43	19	25	

All the vegetables were overall perceived to be unsuitable for eating with burgers, although baked beans, sweetcorn and tomatoes were found to be the most suitable accompaniments. The high number of assessors who thought that peas did not go well with burgers was a surprise as the trio of peas, sweetcorn and baked beans had already been established (Chapter 8) as suitable for eating with children’s convenience foods. The differentiation between peas and sweetcorn was also unexpected because GPA analysis usually shows them plotted very close together, i.e. they are perceived as very similar.

**Table 9.16: Suitability of the sample vegetables for eating with red meat
(i.e pork, ham, beef, lamb)**

	With red meat			Sig.
	Do not go together	Go together	Not sure	
Cauliflower	44	19	24	<i>Non sig.</i>
Carrots	33	32	22	
Baked beans	44	23	20	
Sweetcorn	31	34	22	
Tomatoes	42	16	29	
Turnip	43	17	27	
Cabbage	42	19	26	
Peas	37	28	22	

The differences between the vegetables that were perceived as suited to eating with red meat and those that were not are not clear-cut, and non-significant. Table 9.16 shows that sweetcorn, carrots and peas seem to be the most suitable accompaniments, while unusually baked beans are thought of as more suitable than leafy green vegetables. One possible explanation is that ‘ham’ in Scotland can also mean ‘bacon’, particularly in the West-coast, and children are likely to think of baked beans as going well with bacon.

Table 9.17: Suitability of sample vegetables for eating in soup

	In soup			Sig.
	Do not go together	Go together	Not sure	
Cauliflower	48	11	28	<i>p 0.001</i>
Carrots	27	41	19	
Baked beans	59	4	24	
Sweetcorn	46	19	22	
Tomatoes	40	24	23	
Turnip	44	13	30	
Cabbage	52	11	24	
Peas	38	22	27	

Table 9.17 shows the children’s opinion of the suitability of the eight sample vegetables for making soup. In Scotland, soup is an important part of the diet, either home-made or manufactured (IGD, 1995). The children were clear that baked beans would not make a

pleasant soup but that carrots, tomatoes, peas and sweetcorn would be suitable. It is surprising that more children did not think tomatoes would make nice soup, unless they don't associate 'real' tomatoes with (tinned) tomato soup. It might also have been expected that turnip would be associated with soup as it is a common ingredient in home-made soups with many supermarkets selling 'stew/soup' packs containing the essential ingredients of carrots, turnip and onion. The use of the name 'turnip' (as opposed to 'swede') may have confused them, but the children had already seen photographs of the vegetables during the repertory grid interviews.

Table 9.18: Suitability of the sample vegetables for eating with stew

	With a stew			
	Do not go together	Go together	Not sure	Sig.
Cauliflower	47	17	23	<i>p</i> 0.01
Carrots	30	32	25	
Baked beans	48	14	25	
Sweetcorn	32	28	27	
Tomatoes	48	14	25	
Turnip	39	17	31	
Cabbage	42	15	30	
Peas	30	29	28	

The children reckoned that cauliflower, baked beans, tomatoes, turnip and cabbage were unsuited for eating with or in stews. Carrots, peas and sweetcorn were the only sample vegetables they thought would suit a stew.

Table 9.19: Suitability of the sample vegetables for eating with pies

	With pies			Sig.
	Do not go together	Go together	Not sure	
Cauliflower	42	18	27	<i>p</i> 0.0001
Carrots	39	22	26	
Baked beans	32	31	24	
Sweetcorn	34	26	27	
Tomatoes	46	10	31	
Turnip	48	11	28	
Cabbage	45	11	31	
Peas	28	33	26	

Peas, baked beans, sweetcorn and carrots were the vegetables most suited to eating with pies, as shown in Table 9.19. The usual trio of cauliflower, cabbage and turnip were thought to be inappropriate, as were tomatoes.

Table 9.20: Suitability of the sample vegetables for eating with fish

	With fish			Sig.
	Do not go together	Go together	Not sure	
Cauliflower	44	18	25	<i>p</i> 0.001
Carrots	35	26	26	
Baked beans	45	23	19	
Sweetcorn	29	33	25	
Tomatoes	45	14	28	
Turnip	47	12	28	
Cabbage	43	18	25	
Peas	29	35	23	

Table 9.20 shows that the children thought that peas and sweetcorn were the vegetables that went best with the fish.

Table 9.21: Suitability of the sample vegetables for eating with a cooked breakfast

	With a cooked breakfast			
	Do not go together	Go together	Not sure	Sig.
Cauliflower	55	8	24	<i>p</i> 0.001
Carrots	46	14	27	
Baked beans	27	37	23	
Sweetcorn	46	19	22	
Tomatoes	40	23	24	
Turnip	54	6	27	
Cabbage	51	11	25	
Peas	45	14	28	

A cooked breakfast is similar to a ‘fry-up’ without the inclusion of chips. Baked beans and tomatoes are the only vegetables seen in Table 9.21 to be suitable for eating with a cooked breakfast. In contrast, the other vegetables were seen to be strongly unsuitable for eating with this; a similar results to that for the ‘fry-up’ (Table 9.14).

Overall, cauliflower, cabbage and turnip were not thought to be suited to eating with any of the meals. This suggests that the children were thinking solely in terms of their liking for the samples, rather than being able to make objective judgements of suitability. This isn’t too surprising as the children were likely to imagine eating the meals with each of the vegetables and judging from the preference results (Chapter 8) they would probably be slightly repulsed by thoughts of eating these three unpopular vegetables.

There were a large number of ‘unsure’ responses for each question, suggesting that either the children couldn’t imagine the combination of meal/vegetable, or that they had not understood the question.

9.7 Overall Comments on the Questionnaire

The fact that the parents did not help the children to complete the questionnaires may mean that some of the answers are not representative of the ‘real’ situation. For example, Questions 8-10 regarding the children’s familiarity with the sample vegetables and

others, and Question 12 concerning the shops used by the family to purchase their vegetables (if the children do not accompany their parents, they may have guessed the types of shops frequented). However, if the parents had completed the questionnaires on behalf of their children, they may have answered so as to appear as though their child eats more vegetables than they actually do. This might be in response to possible concerns that they would appear to be a 'bad parent' for not providing a nutritious diet for their child.

The grid representing suitability of the vegetables as accompaniments for common meals showed that the children found sweetcorn, peas, carrots and baked beans to be well-suited to eating with most dishes, while the larger vegetables (cauliflower, cabbage and turnip) were not thought to be suited to any of the options. These results provide a further insight into the preference results from earlier chapters.

Possibly because sweetcorn, peas, carrots and baked beans are suited to eating with most meals, as judged partially by the children's experience of the vegetables their parents serve with particular meals, they are exposed to these vegetables to a greater degree. Thus, in line with theories of Leanne Birch and Patricia Pliner (Pliner, 1982; Birch and Marlin, 1982; Birch *et al.*, 1987), their preferences for these vegetables has increased due to repeated exposure. Conversely, it may be that the children like these vegetables because they are small and sweet, so they eat them more readily than other vegetables. Therefore their parents, knowing that their child likes them, serves these vegetables more often.

CHAPTER TEN: DISCUSSION

10.1 Introduction

Healthy eating habits in childhood are recognised as important, not only in the prevention of childhood diseases (e.g. anaemia, obesity, tooth decay), but also for the establishment of eating habits that frequently persist into adulthood, providing protection against chronic diseases such as cancers, strokes and coronary heart disease (Consumers International, 1996; Caroline Walker Trust, 1992). While British children in general are known to have a high-fat, high-sugar diet that is low in fruit and vegetables, those in Scotland have particularly unhealthy diets (Department of Health, 1989, SOHHD, 1993), with low fruit and vegetables consumption being of particular concern (Anderson *et al.*, 1994a; Wreiden, 1996; Wreiden and Moore, 1995).

Throughout the UK, the consumption of fruit is increasing in line with dietary guidelines at a faster rate than that of vegetables (Cathro *et al.*, 1995), while nationally there are marked differences in the quantity of vegetables consumed within different regions (MAFF, 1996-1998). Scottish households have the lowest intake of vegetables in the UK (MAFF, 1998 p.18) with children often acting as gatekeepers with regard to their family's consumption of vegetables (Piacentini, 1998 pp.88-91; Cathro *et al.*, 1995; Marshall *et al.*, 1994). It is imperative that children's consumption of vegetables is increased, and gaining information about how they perceive vegetables may help us to target them more effectively in healthy eating campaigns.

Repertory grid method (RGM) has been successfully employed in studies of the food perceptions of adolescents and adults for many years (e.g. McEwan and Thomson, 1989; Jack *et al.*, 1997 and 1998). However, based on a thorough search of the appropriate literature it seems that, prior to this thesis, RGM had not previously been applied to the area of children's food perceptions. One of the aims of this research was therefore to test the suitability of the method for use with young subjects. The pilot study aimed to

discover whether children as young as eight years old could elicit constructs using the dyadic method of construct elicitation allied to RGM. Using labelled photographs of the eight sample vegetables as 'prompts', the method evidently succeeded with this age group (refer to Chapter 5), with the children having no difficulty in producing attributes.

10.2 Advantages/disadvantages of RGM compared to other possible methods of data collection.

It is recognised that sensory testing with children is of growing importance to the food industry (Kroll, 1990) yet few studies of product acceptance by young consumers are published. This may be partly due to anticipated difficulties in gaining the full co-operation of children (Moskowitz, 1994). Certainly during the data collection stage of the research presented in this thesis, making the task sufficiently interesting and quick to complete so as to maintain the children's attention was a major concern. Herein lies one advantage of using RGM rather than other quantitative methods (e.g. questionnaires) to obtain perceptual information from children, to a certain extent the children were able to control the length of time that the elicitation process took. The author observed that those children who were most enthusiastic about participating took longer to complete the elicitation stage and also provided more constructs. No problems with the assessors' motivation were experienced during the collection of the perceptual data for this thesis.

As would be expected, RGM has both advantages and disadvantages when compared to other techniques. Compared to using focus groups to generate consensus attributes, individual interviews in RGM prevent distortion of the data due to dominant members within the group, or non-participation by some participants. Therefore every participating child was able to generate sufficient attributes for the subsequent scoring session.

Sensory profiling of samples would have provided a full description of the dominant sensory characteristics of the sample vegetables, but would not allow the aims of this research to be explored. Ultimately, sensory panelists should be objective about the products, so there would be no benefit from using child panelists as opposed to adults.

Additionally, the influence of contextual factors could not be explored in this manner. Training sensory panelists requires a great deal of time to ensure all understand the consensus vocabulary and perceive and score the samples similarly. By allowing the children to generate their own personal constructs using RGM, no such training was necessary. The consensus vocabulary used in sensory profiling is usually generated by the panelists while tasting the samples. Sensory profiling also requires the panelists to taste the samples as they score them. The construct elicitation stage of the RGM and the scoring of the samples were based on the children's impressions of the samples without tasting. This was deliberate to avoid the preparation method influencing the children's perceptions of the vegetables. Using RGM thus limits the samples to those commonly known to the age group of the participating children. If the children were at least familiar with the samples without having necessarily tasted them they could still generate relevant attributes.

Probably the method most similar to RGM is the multiple sorting procedure. This method also tries to categorise people's personal classification systems, which is also the focus of RGM. Multiple sorting procedures involve the assessor choosing all the elements (e.g. vegetable photographs) that have something in common, and then providing a suitable adjective to describe their perception. It continues until the assessor cannot generate any further similarities (Canter *et al.*, 1985). It is possible for just one element to be in a 'group' by itself (see Canter *et al.*, 1985, p.90 for an example). One such multiple sorting method is the Q-sort technique which also examines the way individuals conceptualise events or people that are of significance to them (Canter *et al.*, 1985). However, the Q-sort forces assessors to place elements (i.e. the vegetables in this thesis) into categories so as to give an almost normal distribution of these elements which places restrictions on the participants sorting behaviour (Canter *et al.*, 1985).

Natural grouping is another sorting technique, whereby assessors are asked to split a group of samples into two according to their perceived similarity. They are then asked to provide the adjective that will be the pole for the scale used to score the samples. Natural grouping has been employed in sensory research examining consumer's perceptions of

cuts of meat (Steenkamp and Van Trijp, 1988). An Australian study of adolescents' and adults' perceptions of foods, including eight fruit and vegetables, also used a multiple sorting technique as well as repertory grid to elicit constructs (Worsley *et al.*, 1980).

Multiple sorting techniques are often compared to RGM, and arguments in support of multiple sorting provided by supporters of the method (Steenkamp and Van Trijp, 1988; Canter *et al.*, 1985). Sorting techniques are believed to be more instinctive for participants than the similarity judgements between pairs/triads of samples as used in RGM (Canter *et al.*, 1985). Sorting techniques also allow judgements to be made on a larger number of elements than are suited to RGM because comparisons are not limited to pairs (or triads) of elements (Steenkamp and Van Trijp, 1988; Canter *et al.*, 1985). It has also been found that sorting is quicker than RGM where all possible pairs are compared (Steenkamp and Van Trijp, 1988; Canter *et al.*, 1985), and the resultant data can be also used for multidimensional scaling (Canter *et al.*, 1985). Certainly it was noted that, during the course of collecting the data for this thesis, RGM interviews are very time-intensive, and therefore expensive in terms of manpower.

It has been argued that judgements of similarity used in RGM give truer results than the sorting techniques that force participants to assign elements to pre-determined verbal categories (Schiffman *et al.*, 1981). In a way, these categories are akin to using consensus attributes, and the interviewer must make sure that all participants interpret the categories in the same way. However, Canter *et al.* (1985) disagree, believing that our perceptions of similarities between pairs of elements cannot be summed up by one attribute (p.85 of Canter *et al.*, 1985). This is not the case when using RGM in practice, and the author of this thesis experienced (and encouraged) the children to mention as many similarities and differences (attributes) relating to sample pairs as possible. The only restrictions were that the comparisons were related to the sensory properties of the vegetables and the occasions when they would be eaten.

Another suggested advantage (Canter *et al.*, 1985) of multiple sorting over repertory grid is that bipolar scales are required to score the constructs generated from repertory grid

whereas Canter and colleagues suggest that constructs from multiple sorts do not need to be dichotomous. However, this does not seem to apply to RGM any more than to multiple sorting, as the scales employed for scoring would really depend upon the type of data required.

In favour of RGM, exponents of the method believe that it is more reliable (i.e. reproducible) than multiple sorting (Chapter 6 in Fransella and Bannister, 1977), but this author has no experience of multiple sorting from which to make judgements, and cannot commend either method over the other. The only perceived advantage of RGM over multiple sorting technique is the emphasis solely on similarities between elements with the latter method, as opposed to both similarities and differences when applying RGM. Possibly more constructs are generated using RGM, but there is no evidence for this assumption. It was also suggested (Steenkamp and Van Trijp, 1988) that RGM might be better suited to smaller numbers of products, and the author agrees that conversely RGM would not be too time-consuming to use with a large number of samples. However, ultimately the success of RGM for eliciting the attributes for this research can be measured by the fact that none of the children experienced any difficulty in using it, and all children generated at least six attributes.

Another method that could have possibly been used to collect the necessary perceptual data from the children would have been questionnaires. Questionnaires relating to the children's perceptions of the vegetables would have been quicker to administer to each class as a whole compared to the time taken to conduct the repertory grid interviews. Partly RGM was so time-consuming because only the author was involved. Had other researchers also acted as interviewers, the RGM elicitation stage would have been less disruptive of the normal classroom activities in relation to the time taken. Despite the involvement of just one interviewer, in all the primary schools visited it was common for groups of children to be involved in different activities, so it was easy for participating children to be excused for half an hour without falling behind on the activity. To design a suitable questionnaire would have its own problems. For example, it is possible that without supervision, children might miss out questions resulting in incomplete data sets.

Also, to generate perceptions (i.e. the questions) against which the vegetables could be rated would require a focus group or similar interviews to be conducted. The limitations of focus group interviews have already been discussed in this chapter. Possibly the fact that RGM offers assessors some control over the process of construct elicitation (i.e. the order of pairing of samples, the attributes generated) makes the method more interesting for young participants than the completion of a questionnaire.

10.3 Advantages/Disadvantages of Free Choice over Consensus Data.

Essentially, the personal sets of attributes used by the children meant that the data was free choice by nature. Some researchers who have used RGM to generate constructs relating to assessors' perceptions of food products have then imposed a consensus upon the personal vocabularies so that all assessors are scoring common characteristics (e.g. Jack *et al.*, 1997; Noronha *et al.*, 1995). However, considering the age of the assessors in this thesis, the use of personal attributes for scoring compared to a consensus vocabulary had particular advantages. It can be hard enough to ensure that adult panelists use consensus attributes in a similar and consistent manner, so the use of consensus attributes is likely to be problematic with child assessors.

Free choice profiling (FCP) assumes that while assessors may use different terminology to describe their perceptions, they actually perceive the same stimulus (Williams and Arnold, 1985). As previously discussed in Chapter 3, GPA is then used to analyse the data as it allows for differences in assessors' descriptive vocabulary and also ways in which they use the scale. This means that FCP can be used with untrained consumers. The attributes elicited during RGM are analogous to the descriptors from FCP (Jack and Piggott, 1991/2), but with the former, no tasting is necessary. It has been observed that RGM yields a greater number of attributes compared to FCP (Piggott and Watson, 1991), which may make the resultant sample perceptual maps easier to interpret (Jack and Piggott, 1991/2). However, the attributes are generated based on the comparisons of just two or three products at a time (depending on whether the triadic or the dyadic method of

RGM is used). This can be problematic because these attributes are not always relevant to the group of samples as a whole (Steenkamp and Van Trijp, 1988).

From the research presented in this thesis, it is apparent which attributes relate specifically to just one or two samples rather than explaining the variance explained by the samples as a group. In Chapters 6 and 7, there are particular attributes that relate only to one vegetable (i.e. turnip, or tomatoes), but these perceptions help explain the children's hedonic scores for these samples (e.g. the presence of pips in tomatoes was off-putting). It is at the discretion of the researcher to decide whether to eliminate attributes that are too specific to a particular sample, or to keep them if they are of interest and help the researcher to understand 'the wider picture'.

Another advantage of the use of personal rather than consensus vocabularies in this thesis relates to the organisation of the data collection. Four schools were involved and the data collection spread over a 16-month period (May 1997 to June 1998) allowing mutually convenient times for the author to visit the schools to be arranged. Prior to collecting the data it was thought that the main attributes might differ between the different socio-economic groups and between Glasgow and Edinburgh children. Partly this might be due to different experiences/exposure with vegetables, but also partly to nuances of language. Given this, it would not be possible to generate a consensus vocabulary until children from all the schools had participated. To allow quantitative data to be collected would have necessitated a further visit to each of the schools to distribute score-sheets (or questionnaires) requiring suitable dates to be negotiated once more with each school. By using personal vocabularies, the data from each school could be analysed as soon as the data collecting was completed.

Had a consensus vocabulary been used, the analysis of the results would have been considerably easier. The effect of contextual factors (i.e. age, gender, SES, geography, frequency of vegetable consumption) on the children's perceptions could have readily been examined using correspondence analysis (McEwan and Schlich, 1991/2; Hoffman and Franke, 1986; SPSS, 1994 Categories 6.1, pp.49-63). External preference maps

would have also been constructed initially to examine the effect of the children's perceptions of the vegetables on their preferences rather than having to make inferences by relating the results from GPA to the internal preference maps produced in Chapters 5-7. The use of PRINCALS to examine inter-relationships between contextual variables is seldom used in sensory studies (literature search in May 1999 using FSTA CD-ROM), yet in this study PRINCALS quickly yielded useful information about factors that influenced the frequency of vegetable consumption. It was also beneficial to see graphically the strength of the influence exerted by each contextual variable (as shown in Figure 8.11). A consensus vocabulary was also successfully generated (Chapter 8), allowing more explorative multivariate methods of analysis (e.g. PCA, external preference mapping) to be used than was possible with the 'free-choice' data. No reference to the conversion of free choice sensory data to consensus data could be found in the literature (search in May 1999 using FSTA CD-ROM), so the procedure detailed in Chapter 8 was somewhat experimental in its approach. While the conversion of the data into a consensus vocabulary was time-consuming, ultimately the ease with which the children used their personal vocabularies to score the samples outweighed any disadvantage to the author.

10.4 Use of Rating Scales with Child Assessors.

Many sensory studies involving children focus specifically on their food preferences rather than exploring their perceptions and expectations of foods. The predominance of child studies using the facial and/or verbal hedonic scales (e.g. Chen *et al.*, 1996; Kimmel *et al.*, 1994; Kroll, 1990; Dorian, 1995; Fallon *et al.*, 1984) may be partially due to a belief among some researchers that children cannot cope with linear scales. It is likely that linear scales are too complex for use with very young children. However, research to assess children's ability to comprehend the principles of scaling, including children aged 8 years and above (e.g. Kimmel *et al.*, 1994; Kroll, 1990) have restricted them to child-orientated facial and/or verbal scales. Yet the children (aged between 8-11 years) who participated in the research presented in this thesis encountered no difficulties in comprehending the use of linear scales. The use of linear anchored scales to rank samples

tends to be typically associated with sensory research involving adult assessors, although Moskowitz (1994) also had success using such scales with children, although their ages are not specified.

10.5 Children's Perceptions/Preferences of Vegetables

Regardless of any influence due to contextual factors (Chapter 8), the children perceived baked beans, sweetcorn and peas as being processed, small, soft and juicy, and to be typically eaten with easy to cook children's convenience foods (e.g. sausages, fish-fingers, chicken nuggets, pies and chips). The presence of a sauce is also associated with these three vegetables; either they come in sauce (baked beans) or they can be eaten with sauce. These vegetables (and their associated properties) were extremely popular with the children. The external preference map (Figure 8.15) confirms this, although carrots are also included in this preferable group of vegetables. The presence of a sauce is also less influential on preference than the other attributes associated with these vegetables (see Figure 8.15).

The IGD (1998) reported that carrots are the most frequently eaten vegetable in Britain, and given that repeated exposure to a food increases a child's preference for it (Pliner, 1982; Birch and Marlin, 1982; Birch *et al.*, 1987), it is no surprise that carrots were popular with the children. Carrots and peas were found to be the favourite vegetables of children of the same age group to this study, while teenagers favoured vegetable was sweetcorn (Cathro *et al.*, 1995). Possibly these vegetables are seen by parents to be suitable for consumption by children, and their frequent exposure to them has increased their preferences.

Cauliflower, cabbage, turnip and carrots were thought of as big, hard and crunchy vegetables that were typically eaten with more formal meals including meat. The children believed that these four vegetables were naturally grown as opposed to the other processed vegetables in the sample set. These vegetables and their associated properties were not popular with the children, although this applied less to carrots than the other

three vegetables in this group. The external preference map (Figure 8.15) confirmed the GPA results. A study involving children of a similar age also found that cabbage and Brussels sprouts were the least liked vegetables (Cathro *et al.*, 1995).

Tomatoes were a 'unique' vegetable in terms of the manner in which the children perceive them. This vegetable was seen to be juicy and sweet, but also strongly associated with the presence of pips. PCA (Figure 8.14) confirms this, and the external preference map (Figure 8.15) shows that the pips contribute to the unpopularity of tomatoes with the children. GPA showed that tomatoes were thought to be suited to eating cold, eating in sandwiches, in salads and in soups; properties that explain its isolation from the other seven samples.

It can be inferred from these results that children prefer vegetables that are small, soft and juicy and suited to eating with convenience foods to those that are big, hard, crunchy and associated with formal meals. They do not like the presence of pips in tomatoes which corresponds with Szczesniak's findings (1972) that children dislike textures that make foods difficult to manipulate orally and fear textures that may cause them to choke or gag. More surprising is the finding that the preferred textures were softness and juiciness over hardness and crunchiness. This contradicts the results from the pilot study (Chapter 5), whereby the children preferred crunchy, hard and juicy vegetables. However, examining this more closely, the vegetables from the pilot study that the children preferred were raw carrots, cucumber, celery and red peppers (all eaten raw), while liking cooked carrots, sweetcorn, peas and mushrooms less (all vegetables that they perceived to need cooking). The 'rawness' of the favoured pilot study vegetables may be more important than their textures, whereas in the main study the selection vegetables were perhaps not so readily grouped according to "eat raw" and "eat cooked". It might be the eating occasions that the raw vegetables were associated with (salads, sandwiches, as crudités for dips) that appeals the most to the children compared to a cooked meal.

The textural characteristics of the vegetables were very influential in terms of the children's perceptions of the samples. The Edinburgh assessors (Table 6.1)

predominantly described the vegetables in terms of their textures, with soft, crunchy, hard, squashy and juicy being attributes mentioned by a large proportion of the children. Flavour attributes were mentioned less often, and descriptions were limited to flavoursome/nice taste, sweet and nasty taste. The Glasgow children showed the same awareness of the textural attributes, and diminished consciousness of the flavour of the samples (Table 7.1).

During construct elicitation, the children were asked to imagine they were eating the sample pairs and to describe what they would be like to eat. This could be interpreted equally in terms of flavour and textural characteristics of the vegetables (and even the temperature), yet the children focused more often on the texture. Szczesniak and Kahn (1971) suggested that in the absence of a strong flavour, consumers become more aware of the texture of a food, especially if the food is crunchy or crispy. Given the results presented in Tables 6.1 and 7.1, it seems that the children thought of the vegetables in terms of their texture rather than their flavour. Alternatively it might be that the children were unable to put into words their recollections of the flavour of the vegetables, although it is thought likely that by 8-years-old they would know the meaning of the terms “bitter” and “sour”, but this has not been proven.

When we look at the vegetables favoured in the main study (baked beans, sweetcorn, peas and carrots) they could all be described as “sweet”, whereas the ‘rejected’ vegetables (cauliflower, cabbage and turnip) are the more typical green vegetables which we as adults also commonly associate with bitterness. Other studies have shown that sweet foods are usually preferred over bitter foods by children and adolescents (Ton Nu *et al.*, 1996; Ross, 1995). As has already been argued (Chapter 6), it is likely that young children have not yet had sufficient exposure to bitter foods (Baxter and Schröder, 1997) to overcome their inherent aversion (Steiner, 1977). Therefore, according to many studies (Birch *et al.*, 1987; Birch and Marlin, 1982; Birch *et al.*, 1982), they will reject bitter tasting vegetables in favour of sweet varieties. This innate preference for sweet foods and rejection of bitter ones seems to have a greater influence on their choice of vegetables than the texture does, albeit less consciously. Adults’ vegetable preferences were also

strongly influenced by flavour in an earlier study (Drewnowski, 1996), and the least liked vegetables were those that are bitter (including cabbage and cauliflower).

Dark green vegetables also produce unpleasant odours when cooked, which may contribute to the children's disliking of cauliflower and cabbage. The appearance of these vegetables may also influence the children's dislikes, with children having been found to associate dark green plant foods with unripeness (Maga, 1974) which could be construed as lack of sweetness. Lavin and Lawless (1998) also found that children aged 8-10 years perceived dark green foods to be less sweet than those of a lighter green colour, while Walker *et al.* (1973) discovered that children expected that lighter green vegetables would taste more pleasant than darker green varieties.

The appearance of baked beans, sweetcorn, peas and carrots seem to be influencing the children's liking for them. The smallness of the vegetables was significantly mentioned by the children during RGM. The size may help the children to control these vegetables more readily in their mouths compared to larger, harder vegetables which would require more chewing before they could be swallowed. It may be that small vegetables appear to be 'child-sized', with most children probably familiar with other child-size products such as chicken nuggets, mini sausages, fish-fingers, as well as smaller varieties of fruits and vegetables (e.g. cherry tomatoes, small apples, baby carrots). Other research also found children to favour foods that are bite-sized (Rousseau, 1983), although this referred to snack-foods for which the criteria may differ.

Recently Safeway developed a range of fruit and vegetable snacks especially for children. They particularly choose varieties that were small, brightly coloured and sweet tasting to appeal to their intended consumers (IGD, 1998). The colour of the preferred vegetables may well be influential, as colours have been found to influence expectations of food flavours in adults (Clydedale, 1993; Drewnowski, 1996) and children (Walsh *et al.*, 1990; Lavin and Lawless, 1998). No examples could be found in the literature of children's preferences/expectations for particular colours of vegetables other than dark versus light green (Walker *et al.*, 1973; Maga, 1974; Lavin and Lawless, 1998).

Parental pressure may also have further influenced the children's dislike of turnip, cabbage and cauliflower. If children dislike these vegetables because of the sensory reasons just mentioned, they are likely to refuse to eat them. If the parents cajole the children into eating them, maybe by offering a 'reward', or if they threaten the children into consuming the rejected vegetables it only serves to heighten the children's dislike of the 'target' food, e.g. the unpopular bitter vegetables (Birch *et al.*, 1982 and 1984). Perhaps because the preferred vegetables (carrots, sweetcorn, baked beans, and peas) could be construed as tasting sweet, these vegetables are more popular with the children (who naturally prefer sweet tastants) and therefore the parents do not need to coerce them into eating these.

The questionnaire (Chapter 9) included a grid whereby the assessors indicated how suitable they thought the vegetables were for eating with commonly consumed meals. Cauliflower, cabbage and turnip were not thought to be suitable for eating with any of the suggested meals, which is most likely to be because the children didn't like these vegetables so couldn't imagine eating them with anything. In general terms, baked beans, sweetcorn, peas and carrots were thought to be suited to eating with the majority of meals, although there were some exceptions. Baked beans and tomatoes were the vegetables most suited to eating with both a cooked breakfast and a 'fry-up' (any combination of fried bacon, sausages, egg and chips). From examining the results of the analysis (Tables 9.14 to 9.21), it can be seen that of the liked vegetables (i.e. baked beans, sweetcorn, peas and carrots) were often thought to go well with the meals (soup being another exception, alongside a fry-up and a cooked breakfast), but the order of preference changes according to the meal. So the meal often dictates the vegetables that can be eaten with it, thereby acting in as a slight limitation towards children's vegetable consumption.

So far the children's perceptions and preferences of the vegetables have been discussed in general terms, but one of the aims of this thesis was to examine whether or not certain contextual factors were influential in determining these perceptions and preferences.

10.6 Influence of Socio-Economic Status on Children's Perceptions of and Preferences for Vegetables

Internal preference mapping of all the children's hedonic data (Chapter 8) showed that socio-economic status significantly ($p<0.05$) influenced the children's preferences for the vegetables. The advantaged children had significantly higher preferences for carrots, peas and sweetcorn than the disadvantaged children. Analysing the data according to city of residence, the socio-economic status of the Edinburgh assessors did significantly ($p<0.05$) influence their vegetable preferences (Chapter 6). The disadvantaged children from Edinburgh gave significantly higher hedonic scores to cauliflower, turnip and cabbage than their advantaged peers did (although neither group scored them in the liking portion of the scale). This was also true of the Glasgow assessors (Chapter 7), although the difference was non-significant.

Mann-Whitney tests to reveal any effects of SES on the hedonic scores of all the children (Table 8.11) showed that the disadvantaged assessors gave higher scores for cabbage, cauliflower and (significantly) turnip. The Glasgow advantaged children gave higher mean scores (not significant) to carrots, sweetcorn and peas (Chapter 7), while the Edinburgh advantaged children gave higher scores to carrots, sweetcorn and tomatoes (Chapter 6). Overall, the advantaged children liked baked beans, carrots, peas and tomatoes more than the disadvantaged children did (Table 8.11), although none of these differences reached significance.

There are possible explanations for the differences in the mean hedonic scores given by the two socio-economic groups to the samples. Preference for foods is shown to increase when children are repeatedly exposed to them, especially if the children eat these vegetables (Birch and Marlin, 1982). The children from the disadvantaged schools in both cities received free-school meals. Particularly at the school in the disadvantaged area of Edinburgh, it was required that the children tried the vegetables on offer each day. The teachers sat with their class to 'set an example' and the headteacher believes that this makes a valuable contribution to her pupils' diets. The school in the disadvantaged area

of Glasgow didn't enforce quite such standards, but the children were encouraged to select a portion of vegetables. It is plausible that by taking a school dinner and trying vegetables they might otherwise reject, the disadvantaged assessors were learning to like (or dislike less) vegetables that typically are unpopular with young children. The presence of the teacher at the Edinburgh school in particular is likely to be a positive influence with regard to the children's vegetable preferences (Birch *et al.*, 1980), particularly among the youngest (primary one) pupils.

Another possible explanation for the differences in hedonic scores for turnip, cauliflower and cabbage might be the availability of these varieties in the local shops in the areas of deprivation, or maybe their perceived affordability compared to other vegetables. The parents might buy and prepare these vegetables more often than the parents of the advantaged children, so again the children are more familiar with these varieties. Overall it should be made clear that although the disadvantaged children gave higher hedonic scores for these vegetables on average, they also scored all three in the disliking portion of the scale.

It seems unlikely that seasonality/time-of-year influenced the observed differences in the mean hedonic scores. Turnip, cabbage and cauliflower are probably more readily associated with winter and/or autumn, when infact the advantaged assessors were interviewed in winter (February '97 in Edinburgh; November '97 in Glasgow) while the disadvantaged schools were visited in summertime (May '97 in Edinburgh; June '98 in Glasgow).

Overall more disadvantaged than advantaged assessors mentioned children's convenience foods in association with baked beans, peas and sweetcorn. It is not clear whether the disadvantaged children in this study actually ate more convenience foods than the advantaged children, and information relating socio-economic status to the intake of these types of foods cannot be discerned from the National Food Survey data (MAFF, 1997 and 1998).

A survey examining the influence of socio-economic status on cooking skills (Lang *et al.*, 1996) found that deep-fat fryers and chip pans were more likely to be used in low socio-economic status households than in those of high socio-economic status. This survey also found that low-earning households were less confident in their ability to use 'healthier' methods of cooking foods, for example, shallow-frying, poaching, steaming, stewing or stir-frying foods. These results leads one to speculate that the children from low-income households who participated in this study were indeed consuming more of the convenience foods they mentioned (e.g. sausages, chicken nuggets, chips), although this has not been substantiated by food intake diaries.

It is generally known that low-income families eat less fruit and vegetables than families with higher incomes (MAFF, 1997-1998; Lang, 1997; Leather, 1997; National Children's Home, 1991; Doyle *et al.*, 1994). Lower socio-economic status consumers eat more tinned and frozen vegetables and less fresh vegetables than higher income consumers (MAFF, 1997, Table 2.19: Shepherd *et al.*, 1996), and are less confident in their ability to cook fresh green vegetables (Lang *et al.*, 1996). Research in the USA (Reicks *et al.*, 1994) suggested that low income families ate less fruit and vegetables because they lack storage space, they dislike the sensory properties of fruit and vegetables and they lacked knowledge of preparation and serving styles.

Among the Edinburgh children (Chapter 6), more of the disadvantaged group mentioned the packaging of the vegetables than the advantaged assessors, which was not so obvious among the Glasgow children. It was thought that the lack of shops selling fresh produce in the area surrounding the disadvantaged school might have resulted in this difference. However, in Glasgow the disadvantaged school was in a similar area of deprivation with few food retail facilities, so the reason for the observed difference between the two socio-economic groups in Glasgow is not so obvious. Results from the questionnaire (Chapter 9) do show that the disadvantaged families were significantly ($p \leq 0.01$) more likely to buy their vegetables from a local corner shop or other (unspecified) shops ($p \leq 0.05$) than the advantaged families. The latter were in turn found to be significantly more likely to buy their vegetables from the supermarket ($p \leq 0.005$) or the greengrocer ($p \leq 0.001$), where one

would expect the quality of the produce to be of a higher quality than from a local shop with a slower turnover of stock. These results do suggest that the advantaged children in this study were more likely to eat fresh vegetables rather than processed, and vice-versa for the disadvantaged children.

10.7 Influence of Geography on Children's Perceptions/Preferences of Vegetables

The children's city of residence (Edinburgh versus Glasgow) was not found to have significant effect on their preferences for the vegetables (Table 8.10). Table 9.3 shows the consumption frequencies condensed into just two categories for the purpose of the chi-square analysis and shows no difference at all between the two cities. However, when the frequencies are separated it is apparent that while more Glasgow children said they ate vegetables every day (16 compared to 8 Edinburgh children), fewer of them ate vegetables either 2-3 times per week, or 4-6 times a week.

The results from the analysis of the questionnaire showed that the Edinburgh assessors were significantly ($p \leq 0.05$) more likely than the Glasgow assessors to be involved in choosing the vegetables they ate at home. The Edinburgh children were also significantly ($p \leq 0.05$) more likely to take a school meal than the Glasgow children.

Comparing the perceptual attributes elicited by the Edinburgh children (Table 6.1) compared to the Glasgow children (Table 7.1), there are marked similarities between the assessors from the two cities and no noticeable differences. City of residence does not appear to be as influential as is suggested by PRINCALS, although this technique was used as an exploratory technique.

10.8 Influence of Gender on Children's Perceptions/Preferences of Vegetables

PRINCALS suggested that the sex of the assessors was not a particularly influential factor (Figure 8.12). HOMALS (Figure 8.12) also showed gender to be of minimal importance as regards the children's perceptions of the consensus attributes relative to the samples, although it should be remembered that the data from only 56 assessors were used to construct the consensus data set. Multivariate analysis of variance also found gender to have no significant impact on the children's perceptions of the vegetables for the consensus attributes. Having examined the gender of the assessors citing the attributes that significantly correlated with the dimensions after GPA of the whole data set, there were no apparent differences in the way in which the two sexes perceived the vegetables.

With regard to preferences, the assessor's gender was not found to have a significant effect on their overall vegetable preferences, although Table 8.9 does show that males gave turnip a significantly ($p \leq 0.05$) higher hedonic score than the girls (Chapter 8). Australian research (James *et al.*, 1997) found that 8-9-year-old boys were significantly less able to detect sweet and salty tastants (and non-significantly, bitter) compared to girls. James *et al.* suggested that the ability of boys to detect tastants may not be fully mature at 8-9-years old, whereas girls have reached maturity. It is unlikely that this discrepancy could explain the differences in preference, as cauliflower and cabbage are also considered to be bitter alongside turnip, yet there were no gender differences in preferences for these.

While overall there were no significant effects of gender on the children's reported frequency of weekly vegetable consumption (Table 9.5), during the analysis of the Glasgow data gender differences were found. Glasgow girls were found to eat vegetables significantly ($p < 0.05$) more often than the boys from the city (Chapter 7). It has been found that girls are more aware of the health benefits of eating vegetables (Lund *et al.*, 1990), so it therefore might be expected that they would eat more than boys. Other

studies have also found that females claimed to eat more vegetables than males, with an earlier study also in the west of Scotland (Anderson *et al.*, 1994c) and a UK-wide study (Hackett *et al.*, 1997). There is always the possibility that because girls are more aware of the positive effects of eating vegetables (Lund *et al.*, 1990) and know that they should be eating them regularly, the females in this study were more likely to exaggerate their weekly frequency of consumption. However, without dietary intake information it is not possible to know whether the children's frequency claims are accurate, although dietary survey methodologies are not infallible either (Anderson, 1995).

10.9 Influence of Age on Children's Perceptions/Preferences of Vegetables

The children who participated in the main study varied in age between 8 years 2 months to 10 years 5 months old. The mean age of the 91 children who provided complete data was 9 years old exactly. Just five of the children whose perceptual data was use in the analysis were 10 years old, and just four of those who provided full questionnaire data were aged 10 years. Therefore, any analysis of the potential effects of age on the children's perceptions/preferences was concentrated on the 8 versus the 9-year-olds.

According to the component loadings plot from PRINCALS (not shown) and HOMALS (Figure 8.12) for the consensus attributes, the age of the children was an influential factor. Multivariate analysis of variance also found the assessors' age to be highly significant ($p = 0.001$), but for just two attributes (the presence of a sauce, and the suitability for eating cold). The assessors from Glasgow were on average older than those from Edinburgh (Figure 8.12), but this is clearly explained by the fact that the data collection in Glasgow occurred later in the school year.

In terms of the children's perceptions of the vegetables, no differences due to the age of the assessors were observed. There were, however, differences between the two age groups with regard to their hedonic scores for the vegetables. Chi-square analysis found no significant effect of age overall ($p=0.096$). However, Mann-Whitney tests showed that the 8-year-olds gave turnip significantly ($p \leq 0.01$) higher hedonic scores than did the 9-

year-olds. However, both age groups on average scored turnip in the 'dislike' half of the hedonic scale (i.e. scores below 5). The author can think of no obvious reason for the difference in liking according to age, and for six of the eight vegetables there is no difference of any magnitude between the mean hedonic scores of the two groups. The older children had a higher mean preference score for baked beans than the 8-year-olds, but this narrowly missed significance. Had it been the *older* children who had higher mean scores for turnip, and also for the other 'unpopular' vegetables (i.e. cabbage and cauliflower) it might be suggested that being older, they had had greater exposure to these vegetables and therefore were slightly more receptive towards them. This however was not the case, so no explanation is forthcoming.

10.10 Influence of Frequency of Vegetable Consumption on Children's Perceptions/Preferences of Vegetables

The children were categorised as either low vegetable consumers (LVC) or high vegetable consumers (HVC) on the basis of their alleged weekly vegetable consumption. It was arbitrarily decided to have the LVC/HVC cut-off point at 'four times per week', so that those consuming vegetables less than four-times per week were LVC and those who ate vegetables more often were classified as HVC. Realistically, as neither the number of portions nor the size of the portions eaten was recorded, even those who are HVC may infact not be consuming sufficient quantities of vegetables as suggested by health authorities.

The HVC were not found to be significantly more likely to be from a particular city, income group, age group or of a particular gender (Tables 9.3 to 9.6). Given the results from research cited in the literature review (Chapter 2), it might have been expected that girls, advantaged assessors and those from Edinburgh would eat more vegetables. It might well be that if quantity of intake had been measured as opposed to (or as well as) the frequency of intake then these assumptions might well have been true of this study population. Some of these expectations might have been proven if the LVC/HVC divide

had been classified another way, but the low counts for some weekly intake frequencies would have made chi-square analysis inaccurate.

Frequency of vegetable consumption was found to significantly differ between the different socio-economic groups from the Glasgow schools (Chapter 7). The advantaged children claimed to eat vegetables more frequently than their low socio-economic status counterparts ($p \leq 0.001$). No such difference was observed from the Edinburgh study, and overall the socio-economic status had no significant effect on consumption frequencies.

Given that repeated exposure to foods increases children's preferences to them (Birch *et al.*, 1987), it would be expected that the HVC from this study had higher preferences for the vegetables than the LVC. No significant difference was found between the children's preferences for the vegetables overall dependent on the frequency of their typical weekly consumption. However, Mann-Whitney tests (Table 8.8) showed that the HVC had higher mean hedonic scores than the LVC for all the vegetables except sweetcorn, tomatoes and turnip. These hedonic differences according to frequency of consumption cannot be readily explained by the exposure theory, particularly as none of the observed differences in the scores were significant.

Research with adult females has shown that HVC and LVC differ in the ways in which they perceive vegetables and their usage of them (Cathro *et al.*, 1995). LVC have low taste expectations of vegetables, and tend to eat vegetables because they should rather than because they enjoy them. Conversely, HVC enjoyed the sensory properties of vegetables and ate a wider variety of different types, and had tried cooking familiar varieties in more different ways than the LVC. Both groups know that vegetables are have important health benefits, but for the LVC this is outweighed by negative perceptions regarding factors such as the cost, preparation time, and family preferences (or aversions), especially if there are children in the family (Cathro *et al.*, 1995).

Parents who are LVC and have these negative perceptions of vegetables might be influencing their children's perceptions of vegetables, and subsequently their preferences.

In this study, no real differences were found between the children who were HVC and those who were LVC in their perceptions or their preferences of the sample vegetables. Possibly differences would have become apparent had the children been interviewed in depth about their feelings towards vegetables. The fact that just eight samples could be used for RGM might also have limited the potential differences between the two groups of vegetable consumers. The samples had to be familiar to all the children for repertory grid to be successful, whereas had a wider variety of vegetables been used, differences between the HVC and LVC with regard to familiarity and perceptions might have become more apparent.

10.11 Summation of the Findings of this Research

This thesis has successfully explored all of the aims of the investigation that were outlined in Chapter 3. Scottish children aged between 8-10-years-old have been found to perceive baked beans, sweetcorn and peas as being processed, small, soft and juicy, eaten with sauce or in a sauce and typically eaten with easy to cook children's convenience foods (e.g. sausages, fish-fingers, chicken nuggets, pies and chips). In contrast, cauliflower, cabbage and turnip were thought of as being natural, big, hard and crunchy, and typically eaten with formal meals that include meat. Tomatoes were described as juicy and sweet and along with carrots were associated with soups, salads and eating raw. Tomatoes were additionally suited to eating in sandwiches, while the presence of pips in tomatoes was off-putting to the children.

Table 8.7 shows that carrots and sweetcorn were the vegetables liked the most overall, followed by baked beans and peas. Tomatoes, cabbage, cauliflower and turnip were all disliked by these children. The children's preferences were influenced by socio-economic status with more advantaged assessors liking carrots, sweetcorn and peas according to the internal preference map (Figure 8.5) while overall the high socio-economic status children gave higher hedonic scores to baked beans, carrots, peas and tomatoes than the disadvantaged children (Table 8.11). Also, the disadvantaged assessors gave higher scores for cabbage, cauliflower and (significantly) turnip. There were some differences

between the socio-economic groups in terms of their perceptions of the vegetables, which probably related to their experiences with/exposure to vegetables due to differences in the availability of different varieties between the socially disparate areas.

Neither the age, city of residence, gender nor typical weekly consumption of vegetables were found to significantly influence the children's preferences or perceptions of the sample vegetables. While HOMALS and MANOVA did show differences in the children's perceptions of the consensus attributes due to their social status, city of residence and age, the results were based on data obtained from just over half the assessors.

The texture of the vegetables did influence the children's perceptions and preferences of the sample vegetables. The children demonstrated a heightened awareness of the samples' textural characteristics while their awareness of the flavour of these seemed comparatively to be diminished. Despite the apparent influence of the samples' textural attributes, it was also believed that the flavour of the vegetables (i.e. sweet versus bitter) was additionally responsible for the division between the liked and the disliked vegetables.

A further aim of this thesis was to identify a method for obtaining reliable perceptual information from children. Repertory grid (dyadic method) was found to be a suitable method and was easy to use with children as young as 8-years-old, providing a sufficient number of constructs that related to the samples. It was also determined during the course of this thesis that children aged 8-years-old and older could successfully understand the concept of linear bipolar scales and that they could rank samples accordingly both for their liking of the samples and for the intensity of particular descriptive attributes using such scales.

10.12 Limitations of this Research

The findings related to children's vegetable preferences as presented in this thesis are limited somewhat by the fact that the assessors did not actually taste the sample vegetables. Therefore all findings were only related to the children's previous experience or perceptions of those vegetables. However, the reasons for not asking the children to taste the vegetables have been fully explained in section 4.4.

Given the possibility of bitterness sensitivity affecting the children's liking for dark green vegetables, it might have been worthwhile conducting threshold tests for bitterness and also testing the assessors genetic taste sensitivity to PROP or PTC. This would have enabled correlations between actual sensitivity and liking for green vegetables to be tested.

10.13 Strategies to Increase Vegetable Consumption

Many research projects have investigated barriers and opportunities in relation to vegetable (and fruit) consumption with the aim of developing strategies that could be used to increase intakes among target adult populations (e.g. Cox *et al.*, 1998 and 1966; Kilcast *et al.*, 1996; Cathro *et al.*, 1995; Anderson *et al.*, 1994c; Marshall *et al.*, 1994). In Europe (Brug *et al.*, 1995), and in the United States, intervention studies and investigative projects have also been undertaken to increase fruit and vegetable consumption (Balch *et al.*, 1997; Dittus *et al.*, 1995; Loughrey *et al.*, 1997; Keim *et al.*, 1997). Recognising the importance of establishing good dietary practice during childhood, some researchers have also targeted children (Boaz and Ziebland, 1998; Boaz *et al.*, 1998; Domel *et al.*, 1996 and 1993; Kirby *et al.*, 1995; Baranowski *et al.*, 1993).

Consumer's are usually aware of the health benefits of consuming fruit and vegetables, but do not believe that they themselves are at risk of developing diet-related diseases (Dittus *et al.*, 1995). Also typical is consumers' belief that they already consume sufficient quantities of fruit and vegetables, partly related to misconceptions about

portion sizes (Cox *et al.*, 1998; Marshall *et al.*, 1994). Given that many adults are unaware of the need, or struggle to consume five portions of fruit and vegetables per day, it is likely that few children reach the target (SOHHD, 1993; WHO, 1990) which is also to consume five portions daily.

Children may be uninterested in the role of fruit and vegetables in the prevention of diseases such as fruit and vegetables and cancers because they believe that they are too young to be need to take precautions against diseases that may or may not affect them in thirty-odd years' time. It may be more prudent to address more immediate issues when advising children to increase their vegetable and fruit intake.

Sensory properties commonly act as barriers to the consumption of fruit, and particularly vegetables, with both adults and children often citing unappealing flavours as a reason for their low consumption rates (Cathro *et al.*, 1995; Domel *et al.*, 1996; Keim, 1997). However, the research presented in this thesis illustrates that children often like sweet-tasting vegetables, and furthermore it is suggested that even bitter vegetables can become more acceptable if a child tries them often enough.

The meal with which the vegetables are eaten also seems influential from a child's perspective, with the vegetables typically served with formal meals being less popular. One of the messages from researchers is to add extra 'hidden' vegetables to meals when preparing them (Cathro *et al.*, 1995), and the pilot study (chapter 5) also advocates this as a means of increasing children's vegetable consumption. If the vegetables are mixed throughout a dish such as a pasta bake or a curry, or are smothered in a sauce, children seem happier to eat them. This suggests that it is the flavour rather than the texture of vegetables which is often off-putting to children. Infact, although textural characteristics were frequently mentioned by the children in this study, it seemed to be that the flavour (sub-consciously) influenced their preferences to a greater degree.

Having reviewed research, both current and past, on topics allied to overcoming barriers to vegetable consumption for this thesis, and after conducting original research into

children's perceptions and preferences, some suggestions for increasing consumption are given. School meals are an excellent source of vegetables for many children and are believed to be mainly responsible for the absence of any differences in the frequency of vegetable consumption between the advantaged and the disadvantaged children. The Edinburgh disadvantaged school's policy of serving vegetables with all the meals and making the children at least try them is applauded. This is likely to ensure that they are exposed to vegetables they might otherwise reject, and possibly seeing a respected peer or adult consuming them may influence the children's preferences in a positive manner (Birch *et al.*, 1980).

The Diet Action Plan for Scotland (Scottish Office Department of Health, 1996) recommendation that schools, especially primary schools, provide meals with vegetables and fruit included in the price is also supported by the author. Addressing the issue of sensory properties and preferences, it is suggested that where possible, school meal providers offer a choice of at least two vegetable varieties to pupils. This increases the likelihood of the vegetables provided with the meal actually being consumed by the children, accounting for likes and dislikes.

Recognising that low consumption of vegetables is not confined only to socially-deprived children, a means of targeting all children, regardless of their background is required. Schools are in a unique position to convey messages about healthy eating to their pupils, and many schools do spend time on this important topic. Recently, 'Making Healthy choices About Food Day' saw all the schools in the Craigmillar area of Edinburgh (including the disadvantaged school that participated in this research) spend a whole day teaching children about choosing a healthy diet and included healthy options in the school canteen (City of Edinburgh Education News, Issue 12, June 1999). If the canteens can continue providing healthy options, the children's enthusiasm and interest may be maintained.

There has been success reported recently with increasing children's consumption of vegetables and maintaining these increases. The 'Food Dudes' are characters used on

videos shown to children as part of a research project to increase children's consumption by using peer modelling (Horne *et al.*, 1998 and 1995). The Food Dudes are shown enjoying eating a range of fruit and vegetables and extolling the benefits of eating particular 'target' fruit and vegetables. Children are then rewarded for their consumption of the target fruit and vegetables, receiving Food Dude prizes.

Contrary to theories about rewarding the consumption of targeted foods (Birch *et al.*, 1982 and 1984), the Food Dudes programme has increased consumption and six months after the intervention, some of this increase has been sustained (Horne *et al.*, 1998). This demonstrates the influence that respected peers can have over children's food preferences, which reinforces the Edinburgh disadvantaged school's policy that children sit with their teacher at mealtimes in a bid to increase consumption of vegetables. By showing the Food Dudes enjoying fruit and vegetables, the children's perceptions of them as having unpleasant sensory properties is challenged. Intervention strategies such as this should be encouraged nation-wide, with regular checks to ensure that consumption is remaining above baseline levels.

Progress has already been made in some socially deprived areas at increasing residents' access to fresh fruit and vegetables. Community food co-operatives (e.g. Barri Grubb, and the Oxfams Neighbourhood Centre, both in Edinburgh), often established by the residents themselves, mean that fresh produce is easier to obtain, and often more affordable, therefore is more likely to be consumed by lower income consumers and hopefully their children.

Given the frequency with which processed vegetables were mentioned during construct elicitation, especially by the disadvantaged assessors, it is obvious that tinned and frozen vegetables are important with regard to children's consumption. Consumers should be made more aware of the benefits of consuming vegetables in any form, and that frozen vegetables can in fact be better than 'fresh' vegetables that have been stored for too long. In this way, parents that have to rely on processed vegetables as opposed to fresh could be

10.14 Suggestions for Further Research

Parental attitudes towards/consumption of foods have been shown to have a variable influence on their children's consumption of the food depending on which study you refer to. Some researchers have found minimal communality (Birch, 1980a) whilst others have found significant correlations between the preferences of parents and their offspring (Pliner, 1983; Pliner and Pelchat, 1986) including for certain fruits and vegetables (Gibson *et al.*, 1998). Rozin reported variable correlations of parent-child similarities depending on the food in question (Rozin, 1991; Rozin *et al.*, 1984). Given the potential influence that families can have on a child's food preferences, it would be of interest to study the perceptions and preferences of children and their parents and siblings with relation to vegetables.

Parents can be important gatekeepers in respect of their family's consumption of vegetables. They are most likely to purchase and prepare vegetables for consumption by the family, and their attitudes may also influence their children's perceptions of vegetables. Examining the attitudes of parents (among other consumers) towards vegetables has been successfully conducted by previous researchers (e.g. Piacentini, 1998; Cathro *et al.*, 1995), and children's attitudes and preferences have also been explored (Cathro *et al.*, 1995; Domel *et al.*, 1996 and 1993; Kirby *et al.*, 1995; Baranowski *et al.*, 1993). However, it would be interesting to examine parents' perceptions of vegetables and to then involve them in an intervention strategies to increase their consumption of vegetables (e.g. as for Cathro *et al.*, 1995), but to simultaneously obtain perceptual information from their children before and after the intervention. The children's consumption of vegetables (pre- and post-intervention) could also be recorded to examine the effect that an intervention study aimed at parents has on their children's consumption.

Another suggestion for further research continues on from the success of the use of RGM with the children in this study. Although no significant differences were found in the

perceptions of children from Glasgow compared to Edinburgh which might have explained the differences in vegetable consumption between the cities, a similar study of Scottish versus English children might yield interesting national differences. With retrospect, the collection of more detailed vegetable consumption information would have been beneficial, and future studies would do well to consider this.

Another off-shoot from this research could include a study of the suitability of RGM for use with younger subjects and their ability to use anchored linear intensity scales. As it stands, this research has already opened up the possibility of future research into children's perceptions of all manner of foods using RGM as a means of generating attributes.

REFERENCES

- Abbott, J.A. (1972). Sensory assessment of food texture. *Food Technology*, January, 40-49.
- Acheson, R.M. and Williams, D.R.R. (1983). Does consumption of fruit and vegetables protect against stroke? *Lancet*, I, 1191-1193.
- Ajzen, I. (1991). The theory of planned behaviour. In E.A. Locke (ed.) *Organizational Behavior and Human Decision Processes*, 50, 179-211.
- Ajzen, I. and Fishbein, M. (1980). *Understanding Attitudes and Predicting Social Behavior*, Prentice-Hall, Englewood Cliffs, New Jersey, pp. 70-71.
- American Society for Testing and Materials (ASTM) (1968). *Manual on Sensory Testing Methods*. ASTM STP 434.
- Amerine, M.A., Pangborn, R.M. and Roessler, E.B. (1965). Laboratory studies: types and principles. Chapter 6 in *Principles of Sensory Evaluation of Food*, Academic Press, London, pp.275-320.
- Anderson, A.S. (1995). An overview of diet survey methodology. *British Food Journal*, 97 (7), 22-26.
- Anderson, A.S. and Hunt, K. (1992). Who are the "healthy eaters"? Eating patterns and health promotions in the west of Scotland. *Health Education Journal*, 51, 3-10.
- Anderson, A.S., Ellaway, A., Macintyre, S., McColl, K., Callander, R. and Oswald, J. (1996). *Community Food Initiatives in Scotland*. Final report of a review commissioned by the Health Education Board for Scotland. August.

- Anderson, A.S., Macintyre, S. and West, P. (1994a). Dietary patterns among adolescents in the west of Scotland. *British Journal of Nutrition*, 71, 111-122.
- Anderson, A.S., Hunt, K., Ford, G. and Finnigan, F. (1994b). One apple a day? Fruit and vegetable intake in the west of Scotland. *Health Education Research*, 9 (3), 297-305.
- Anderson, A.S., Lean, M.J.E., Foster, A. and Marshall, D. (1994c). Ripe for change: fruit and vegetables in Scotland – current patterns and potential for change. *Health Education Bulletin*, 52 (1), 55-64.
- Anliker, J.A., Bartoshuk, L., Ferris, A.M. and Hooks, L.D. (1991). Children's food preferences and genetic sensitivity to the bitter taste of 6-*n*-propylthiouracil (PROP). *American Journal of Clinical Nutrition*, 54, 316-320.
- Anonymous (1997a). Just another Wacky idea? *The Vegetarian*, 6 (2), 4-5.
- Anonymous (1997b). Mixed reception for Wacky veg. *Cost Sector Catering*, June, p.7.
- Arnold, G.M. and Williams, A.A. (1986). The use of generalised Procrustes techniques in sensory analysis. Chapter 7 in J.R. Piggott (ed.) *Statistical Procedures in food Research*, Elsevier Applied Science, London, pp.233-253.
- Ault, R.L. (1983). *Children's Cognitive Development*, 2nd edition, Oxford University Press, New York.
- Babicz-Zielińska, E. (1999). Preference and consumption of vegetables and fruit among schoolchildren. *Polish Journal of Food and Nutrition Sciences*, 8 (49), 109-116.
- Balch, G.I., Loughrey, K., Weinberg, L., Lurie, D. and Eisner, E. (1997). Probing consumer benefits and barriers for the national 5-a-day campaign: focus group findings. *Journal of Nutrition Education*, 29 (4), 178-183.

Bandura, A. (1973). *Social Learning Theory*, Prentice-Hall, Englewood Cliffs, New Jersey.

Baranowski, T., Domel, S., Gould, R., Baranowski, J., Leonard, S., Treiber, F. and Mullis, R. (1993). Increasing fruit and vegetable consumption among 4th and 5th grade students: results from focus groups using reciprocal determinism. *Journal of Nutrition Education*, 25 (3), 114-120.

Bartoshuk, L.M.(1980). Separate worlds of taste. *Psychology Today*, 14 (4), 48-63.

Baxter, I.A. and Schröder, M.J.A. (1997). Vegetable consumption amongst Scottish children: a review of the determinants and proposed strategies to overcome low consumption. *British Food Journal*, 99 (10), 380-387.

Baxter, I.A., Jack, F.R. and Schröder, M.J.A. (1998). The use of repertory grid method to elicit perceptual data from primary school children. *Food Quality and Preference*, 9 (1/2), 73-80.

Baxter, I.A., Schröder, M.J.A. and Bower, J.A. (1999). The influence of socio-economic background on the perceptions of vegetables among Scottish primary school children. *Food Quality and Preference*, 10 (4/5), 261-272.

Beail, N. (1985). An introduction to repertory grid techniques. Chapter 1 in N. Beail (ed) *Repertory Grid Techniques and Personal Constructs: Applications in Clinical & Educational Settings*. Croom Helm, London, pp. 1-24.

Bingham, S.A. (1987). The dietary assessment of individuals: methods, accuracy, new techniques and recommendations. *Nutrition Abstracts and Reviews (Series A)*, 57, 705-42.

Birch, L.L. (1979). Dimensions of pre-school children's food preferences. *Journal of Nutrition Education*, 11 (2), 77-80.

Birch, L.L. (1980a). The relationship between children's food preferences and those of their parents. *Journal of Nutrition Education*, 12, 14-18.

Birch, L.L. (1980b). Effects of peer models' food choices and eating behaviours on preschooler's food preferences. *Child Development*, 51, 489-496.

Birch, L.L. (1990). Development of food acceptance patterns. *Developmental Psychology*, 26, 515-519.

Birch, L.L. (1993). Children, parents and food. *British Food Journal*, 95 (9), 11-15.

Birch, L.L. and Marlin, D.W. (1982). "I don't like it; I never tried it": effects of exposure to food on children's food preferences. *Appetite*, 4, 353-360.

Birch, L.L. and Sullivan, S.A. (1982). Measuring children's food preferences. *Journal of School Health*, 61, 212-214.

Birch, L.L., Zimmerman, S. and Hind, H. (1980). The influences of socio-affective context on preschool children's food preferences. *Child Development*, 51, 856-61.

Birch, L.L., Birch, D., Marlin, D.W. and Kramer, L. (1982). Effects of instrumental consumption on children's food preferences. *Appetite*, 3, 125-134.

Birch, L.L., Marlin, D.W. and Rotter, J. (1982). Eating as the "means" activity in a contingency: effects of young children's food preferences. *Child Development*, 55, 432-439.

Birch, L.L., McPhee, L., Shoba, B.C., Pirok, E. and Steinberg, L. (1987). What kind of exposure reduces children's food neophobia? Looking versus tasting, *Appetite*, 9, 171-178.

Birch, L.L., McPhee, L., Steinberg, L. and Sullivan, S. (1990). Conditional flavor preferences in young children. *Physiology and Behavior*, 47, 501-505.

Birch, L.L., Johnson, S.L. and Fisher, J.A. (1995). Children's eating: the development of food acceptance patterns. *Young Children*, 50 (2), 71-78.

Birch, L.L., Orlet-Fisher, J. and Grimm-Thomas, K. (1996). The development of children's eating habits. Chapter 4 in H.L. Meiselman and H.J.H. MacFie (eds.) *Food Choice, Acceptance and Consumption*, Chapman & Hall Inc., London, pp.161-206.

Boaz, A. and Ziebland, S. (1998). A 'five-a-day' fruit and vegetable pack for primary school children. Part I: development and pre-testing. *Health Education Journal*, 57, 97-104.

Boaz, A., Ziebland, S., Wyke, S. and Walker, J. (1998). A 'five-a-day' fruit and vegetable pack for primary school children. Part II: controlled evaluation in two Scottish schools. *Health Education Journal*, 57, 105-116.

Boulton-Smith, C., Smith, W.C.S., Woodward, M. and Tunstall-Pedoe, H. (1991). Nutrient intakes of difference social-class groups: results from the Scottish Heart Health Study (SHHS). *British Journal of Nutrition*, 65, 321-335.

Boulton-Smith, C., Woodward, M. and Tunstall-Pedoe, H. (1992). The Scottish Heart Health Study. Dietary intake by food frequency questionnaire and odds ratio for coronary heart disease. II. The antioxidant vitamins and fibre. *European Journal of Clinical Nutrition*, 46, 85-93.

Bourne, M.C. (1976). Texture of Fruit and Vegetables. Chapter 7 in J.M. DeMan, P.W. Voisey, V.F. Rasper and D.W. Stanley (eds) *Rheology and Texture in Food Quality*. AVI Publishing Co., inc. Westport, Connecticut, pp. 275-307.

Bourne, M.C. (1982). Sensory Methods of Texture and Viscosity Measurement. Chapter 6 in *Food Texture and Viscosity: Concept and Measurement*. Academic Press, London, pp.247-279.

Boyar, M.M. and Kilcast, D. (1986). Food texture and dental science. *Journal of Texture Studies*, 17, 221-252.

Brennan, J.G. (1984). Texture perception and measurement. Chapter 3 in J.R. Piggott (ed) *Sensory Analysis of Foods*. Elsevier Applied Science: London, pp. 59-91.

Brug, J., Debie, S., van Assema, P. and Weijts, W. (1995). Psychosocial determinants of fruit and vegetable consumption among adults: results of focus group interviews. *Food Quality and Preference*, 6, 99-107.

Canter, D., Brown, J. and Groat, L. (1985). A multiple sorting procedure for studying conceptual systems. Chapter 5 in M. Brenner, J. Brown and D. Canter (eds.) *The Research Interview: Uses and Approaches*. Academic Press, London, pp.79-114.

Cardello, A.V., Maller, O., Kapsalis, J.G. , Segars, R.A., Sawyer, F.M., Murphy, C. and Moskowitz, H.R. (1982). Perception of texture by trained and consumer panellists. *Journal of Food Science*, 47, 1186-1197.

Carstairs, V. and Morris, R. (1991). *Deprivation and Health in Scotland*. Aberdeen University Press, Aberdeen.

Casey, M.A. and Krueger, R.A. (1994). Focus group interviewing. Chapter 4 in H.J.H. MacFie and D.M.H. Thomson (eds.) *Measurement of Food Preferences*, Blackie Academic & Professional, Glasgow, pp. 77-96.

Cathro, J., Morris, L., James, A.S. and Kilcast, D. (1995). *Increasing the Consumption of Vegetables Amongst Target Groups*. MAFF R&D Surveillance Report 83. London: Leatherhead Food Research Association.

Chen, A.W., Resurreccion, A.V.A. and Paguio, L.P. (1996). Age appropriate hedonic scales to measure food preferences of young children. *Journal of Sensory Studies*, 11 (2), 141-163.

Christensen, C.M. (1984). Food texture perception. *Advances in Food research*, 29, 159-199.

Civille, G.V. and Liska, I.H. (1974). Modifications and applications to foods of the General Foods Sensory Texture Profile Technique. *Journal of Texture Studies*, 6, 19-31.

Civille, G.V. and Szczesniak, A.S. (1973). Guidelines to training a texture profile panel. *Journal of Texture Studies*, 4, 204.

Clark, G.M., MacLellan, M., MacKie, L. and Skerratt, S. (1996). *Food Availability and Food Choice in remote and Rural Areas*. Research project conducted in the Western Isles of Scotland. 1995. Health Education Board for Scotland, Edinburgh.

Clydesdale, F.M. (1993). Color as a factor in food choice. *Critical Reviews in Food Science and Nutrition*, 33 (1), 83-101.

Consumers International (1996). *A Spoonful of Sugar. Television Advertising Aimed at Children: An International Comparative Survey*. Consumers International. November 1996. London.

Contento, I.R. (1991). Children's dietary knowledge, skills and attitudes: measurement issues *Journal of School Health*, 61, 208-211.

Cowart, B. and Beauchamp, G. (1986). The importance of sensory context in young children's acceptance of salty tastes. *Child Development*, 57, 1034-39.

Cox, D.N., Anderson, A.S., Lean, M.E.J. and Mela, D.J. (1995). Identifying barriers to increasing fruit and vegetable consumption in the UK: preliminary findings. *Appetite*, 24, 267.

Cox, D.N., Anderson, A.S., McKellar, S., Reynolds, J., Lean, M.E.J. and Mela, D.J. (1996). Vegetables and fruits: barriers and opportunities for greater consumption. *Nutrition & Food Science*, 5, September/October, pp. 44-47.

Cox, D.N., Anderson, A.S., Lean, M.E.J. and Mela, D.J. (1998). UK consumer attitudes, beliefs and barriers to increasing fruit and vegetable consumption. *Public Health Nutrition*, 1 (1), 61-68.

Crombie, I.K., Smith, W.C.S., Kenicer, M.B. and Tunstoe-Pedoe, H. (1986). Geographical variation in coronary heart disease mortality in Scotland. *Health Bulletin*, 44 (4), 193-202.

Department of Health (1989). *The Diets of British Schoolchildren*. Report on Health and Social Subjects No. 36. Sub-Committee on Nutritional Surveillance and Committee on Medical Aspects of Food Policy. HMSO, London.

Department of Health (1992). *The Health of the Nation*. The Stationery Office, London.

Department of Health (1994). *Nutritional Aspects of Cardiovascular Disease*. Report of the Cardiovascular Review Group. Committee on Medical Aspects of Food Policy. Report on Health and Social Subjects 46. The Stationery Office, London.

Department of Health (1999). *Saving Lives; Our Healthier Nation*. The Stationery Office, London. Also available on the internet at: www.ohn.gov.uk

Desor, J.A., Maller, O. and Turner, R.E. (1973). Taste acceptance of sugars by human infants. *Journal of Comparative and Physiological Psychology*, 84, 496-501.

Diamantopoulos, A. and Schlegelmilch, B.B. (1997). *Taking the Fear Out of Data Analysis*. The Dryden Press, London.

Dibb, S. and Castell, A. (1995) *Easy to Swallow, Hard to Stomach; The Results of a Survey of Food Advertising on Television*. The National Food Alliance, London.

Dijksterhuis, G. (1996). Procrustes analysis in sensory research. Chapter 7 in T.Naes and E. Risvik (eds.) *Multivariate Analysis of Data in Sensory Science*, Elsevier Science B.V., Amsterdam, pp. 185-219.

Dijksterhuis, G. and Punter, P. (1990). Interpreting generalized Procrustes analysis 'analysis of variance' tables. *Food Quality and Preference*, 2 (4), 255-265.

Dittus, K.L., Hilles, V.N. and Beerman, K.A. (1995). Benefits and barriers to fruit and vegetable intake: relationship between attitudes and consumption. *Journal of Nutrition Education*, 27, 120-126.

Domel, S.B., Baranowski, T., Davis, H., Leonard, S.B., Riley, P. and Baranowski, J. (1993a). Measuring fruit and vegetable preferences among 4th and 5th grade students. *Preventive Medicine*, 22, 866-879.

Domel, S.B., Baranowski, T., Davis, H., Thompson, W.O., Leonard, S.B., Riley, P., Baranowski, J., Dudovitz, B. and Smyth, M. (1993b). Development and evaluation of a school intervention to increase fruit and vegetable consumption among 4th and 5th grade students. *Journal of Nutrition Education*, 25, 345-349.

Domel, S.B., Thompson, W.O., Davis, H.C., Baranowski, T., Leonard, S.B. and Baranowski, J. (1996). Psychosocial predictors of fruit and vegetable consumption among elementary school children. *Health Education Research*, 11, 299-308.

Donkin, A.J.M., Neale, R.J. and Tilson, C. (1993). Children's food purchase requests. *Appetite*, 21, 291-294.

Dorian, D. (1995). Consumer testing of confectionery products with children: a review. *The manufacturing Confectioner*, 75 (6), 59-64.

Dowler, E. and Calvert, C. (1995). *Nutrition and Diet in Lone-Parent Families in London*. Family Policy Studies Centre, London.

Doyle, W., Jenkins, S., Crawford, M.A. and Puvandendran, K. (1994). Nutritional status of school children in an inner city area. *Archives of Diseases of childhood*, 70 (5), 376-381.

Drewnowski, A. (1996). From asparagus to zucchini: mapping cognitive space for vegetable names. *Journal of the American College of Nutrition*, 15 (2), 147-153.

Drewnowski, A. and Hann, C. (1999). Food preferences and reported frequencies of food consumption as predictors of current diet in young women. *American Journal of Clinical Nutrition*, 70 (1) 28-36.

Drewnowski, A. and Rock, C.L. (1995). The influence of genetic taste markers on food acceptance. *American Journal of Clinical Nutrition*, 62, 506-511.

Drewnowski, A., Henderson, S.A. and Shore, A.B. (1997a). Genetic sensitivity to 6-*n*-propylthiouracil (PROP) and hedonic responses to bitter and sweet tastes. *Chemical Senses*, 22, 27-37.

Drewnowski, A., Henderson, S.A. and Shore, A.B. (1997b). Taste responses to naringin, a flavonoid, and the acceptance of grapefruit juice are related to genetic sensitivity to 6-*n*-propylthiouracil. *American Journal of Clinical Nutrition*, 66, 391-397.

Duckworth, R.B. (1966). *Fruit & Vegetables*, Pergamon Press, Oxford.

Earthy, P.J., MacFie, H.J.H. and Hedderley, D. (1997). Effect of question order on sensory perception and preferences in central location trials. *Journal of Sensory Studies*, 12, 215-237.

East, R. (1997). *Consumer Behaviour: Advances and Applications in Marketing*. Chapter 5 'Attitudes, beliefs, intentions and behaviour' pp.109-132 and Chapter 6 'Predicting and explaining action' pp. 131-160. Prentice-Hall, London.

EIU Retail Business (1995). Market Survey 2: frozen vegetables. No. 450. August, 37-58.

Fallon, A.E., Rozin, P. and Pliner, P. (1984). The child's conception of food: the development of food rejections with special reference to disgust and contamination sensitivity. *Child Development*, 55, 566-575.

Fishbein, M. and Ajzen, I. (1975). *Belief, Attitude, Intention and Behaviour. An Introduction to Theory and Research*. Addison-Wesley, Reading, MA.

Food Science & technology Abstracts CD-ROMs (1969 to present), IFIS Publishing, Silver Platter International, N.V.

Forsyth, A., Macintyre, S. and Andersin, A. (1994). Diets for disease? Intraurban variation in reported food consumption in Glasgow. *Appetite*, 22, 259-274.

Foster, A. and McColl, K. (1997). Increasing vegetable and fruit consumption; interventions to change attitudes and improve access. Chapter 7 in I. Sharp (ed) *At Least Five A Day. Strategies To Increase Vegetables and Fruit Consumption*. National Heart Forum. The Stationery Office, London, pp. 77-85.

Fransella, F. and Bannister, D. (1977). *A Manual for Repertory Grid Technique*. Academic Press, London.

Gacula, M.C. (1997). Descriptive sensory analysis methods. Chapter 1.1 in M.C. Gacula (ed.). *Descriptive Sensory Analysis in Practice*, Food & Nutrition Press, Inc. Connecticut, pp.5-13.

Gains, N. and Thomson, D.M.H. (1990). Contextual evaluation of canned lagers using repertory grid method. *International Journal of Food Science & Technology*, 25, 699-705.

Gibson, E.L., Wardle, J. and Watts, C.J. (1998). Fruit and vegetable consumption, nutritional knowledge and beliefs in mothers and children. *Appetite*, 31, 205-228.

Gorn, G.J. and Goldberg, M.E. (1982). Behavioral evidence of the effects of televised food messages on children. *Journal of Consumer Research*, 9, 200-205.

Gregory, J., Foster K., Tyler, H. and Wiseman, M. (1990). *The Dietary and Nutritional Survey of British Adults*. For the Office of Population Censuses and Surveys. HMSO, London.

Greenhoff, K. and MacFie, H.J.H. (1994). Preference mapping in practice. Chapter 6 in H.J.H. MacFie and D.M.H. Thomson (eds.) *Measurement of Food Preferences*, Blackie Academic & Professional, London, pp. 137-166.

Haard, N.F. (1997). Product composition and the quality of frozen foods. Chapter 14 in M.C. Erikson and Y.C. Hung (eds.) *Quality in Frozen foods*, Chapman & Hall, New York, pp.275-295.

Hackett, A.F., Kirby, S. & Howie, M. (1997). A national survey of the diet of children aged 13-14 years living in urban areas of the United Kingdom. *Journal of Human Nutrition & Dietetics*, 10, 37-51.

Hair, J.E., Anderson, R.E., Tatham, R.L. and Black, W.C. (1995). *Multivariate Data Analysis with Readings*. Prentice-Hall International Editions: New Jersey. Fourth Edition, p.513.

Health Education Authority (1995). *Diet and Health in School Age Children*. A briefing paper prepared for the Health Education Authority. Health Education Authority, London.

Hedderley, D. and Wakeling, I. (1995). A comparison of imputation techniques for internal preference mapping using Monte Carlo simulation. *Food Quality and Preference*, 6 (4), 281-297.

Hoffman, D.L. and Franke, G.R. (1986). Correspondence analysis: graphical representation of categorical data in marketing research. *Journal of Marketing Research*, 23 (August), 213-227.

Home, P.J., Lowe, C.F., Fleming, P.F.J. and Dowey, A.J. (1995). An effective procedure for changing food preferences in 5-7-year-old children. *Proceedings of the Nutrition Society*, 54, 441-452.

Horne, P.J., Lowe, C.F., Bowdery, M. and Egerton, C. (1998). The way to healthy eating for children. *British Food Journal*, 100 (3), 133-140.

Institute of Grocery Distribution (IGD) (1995). *Scotland in Perspective: an overview of the Scottish grocery market*. IGD Business Publications, London. January.

Institute of Grocery Distribution (IGD) (1998). *Food Consumption '98: the one-stop guide to the food consumer*. IGD Business Publications, London. September.

Jack, F.R. and Piggott, J.R.(1991/2). Free choice profiling in consumer research. *Food Quality and Preference*, 3 (3), 129-134.

Jack, F.R., Piggott, J.R. and Paterson, A. (1994). Use and appropriateness in cheese choice, and an evaluation of attributes influencing appropriateness. *Food Quality and Preference*, 5, 281-290.

Jack, F.R., O'Neill, J., Piacentini, M.G. and Schröder, M.J.A. (1997). Perception of fruit as a snack: a comparison with manufactured snack foods. *Food Quality and Preference*, 8 (3), 175-182.

Jack, F.R., Piacentini, M.G. and Schröder, M.J.A. (1998). Perception and role of fruit in the workday diets of Scottish lorry drivers. *Appetite*, 30, 139-149.

James, C.E., Laing, D.G. and Oram, N. (1997). A comparison of the ability of 8-9-year-old children and adults to detect taste stimuli. *Physiology & Behavior*, 62 (1), 193-197.

Jerzsa-Latta, M., Krondl, M. and Coleman, P. (1990). Use and perceived attributes of cruciferous vegetables in terms of genetically-mediated taste sensitivity. *Appetite*, 15, 127-134.

- Kalat, J.W. and Rozin, P. (1973). "Learned safety" as a mechanism in long-delay taste-aversion learning in rats. *Journal of Comparative and Physiological Psychology*, 83 (2), 198-207.
- Kalmus, H. (1971). Genetics of taste. In L.M. Beidler (ed) *Handbook of Sensory Physiology*, pp. 165-179. Berlin: Springer-Verlag.
- Kaminski, L.C., Henderson, S.A. and Drewnowski, A. (2000). Young women's food preferences and taste responsiveness to 6-n-propylthiouracil (PROP). *Physiology & Behavior*, 68, 691-697.
- Kelly, G.A. (1955). *The Psychology of Personal Constructs* (2 volumes), Norton, New York.
- Kilcast, D., Cathro, J. and Morris, L. (1996). Practical approaches to increasing vegetable consumption. *Nutrition & Food Science*, 5 (Sept/Oct), 48-51.
- Kimm, S.Y.S., Gergen, P.J., Malloy, M., Dessor, C. and Carrol, M. (1990). Dietary patterns of US children: implications for disease prevention. *Preventive Medicine*, 19, 432-442. *Journal of Nutrition Education*, 27, 261-271.
- Kimmel, S.A., Sigman-Grant, M. and Guinard, J.X. (1994). Sensory testing with young children. *Food Technology*, March, 92-99.
- Kirby, S.D., Baranowski, T., Reynolds, K.D., Taylor, G. and Binkley, D. (1995). Children's fruit and vegetable intake: socio-economic, adult-child, regional and urban-rural influences. *Journal of Nutrition Education*, 27, 261-271.
- Kleim, K.S., Stewart, B. and Voichick, J. (1997). Vegetable and fruit intake and perception of selected young adults. *Journal of Nutrition Education*, 29 (2), 80-85.

- Koivisto, U.K. and Sjoden, P.O. (1996). Food and general neophobia in Swedish families: parent-child comparisons and relationships with serving specific foods. *Appetite*, 26 (2) 107-118.
- Kroll, B.J. (1990). Evaluating rating scales for sensory testing with children. *Food Technology*, November, 78-86.
- Laforge, R.G., Greene, G.W. and Pochaska, J.O. (1994). Psychosocial factors influencing low fruit and vegetable consumption. *Journal of Behavioural Medicine*, 17 (4), 361-374.
- Land, D.G. and Shepherd, R. (1986). Scaling and raking methods. Chapter 6 in J.R. Piggott (ed.) *Sensory Analysis of Foods*. Elsevier Applied Sciences: London, pp. 155-185.
- Lang, T. (1997). Dividing up the cake: food as social exclusion. Chapter 14 in A. Walker and C. Walker (eds.) *Britain Divided: the Growth of Social Exclusion in the 1980's and 1990's*. Child Poverty Action Group, London, pp. 213-228.
- Lang, T., Caraher, M., Dixon, p. and Carr-Hill, R. (1996). Class, income and gender in cooking: results from an English survey. In J.S.A. Edwards (ed.) *Culinary and Sciences. Global and National Perspectives*. Computational Mechanics Publications, London, pp.415-425.
- Langron, S.P. (1983). The application of Procrustes statistics to sensory profiling. In A.A. Williams and R.K. Aitken (eds.) *Sensory Quality in Foods and Beverages: Definition, Measurement and Control*, Ellis Horwood, Chichester, pp.89-95.
- Larmond, E. (1976). Sensory measurement of food texture. Chapter 17 in J.M. DeMan, P.W. Voisey, V.F. Rasper and D.W. Stanley (eds.) *Rheology and Texture in Food Quality*. AVI Publishing Co Inc., Westport, Connecticut.

- Lavin, J.G. and Lawless, H. T. (1998). Effects of color and odor on judgements of sweetness among children and adults. *Food Quality and Preference*, 9 (4), 283-289.
- Leather, S. (1992). Less money, less choice: poverty and diet in the UK today. Chapter 5 in *Your Food: Whose Choice?* National Consumer Council, HMSO, London, pp. 72-94.
- Leather, S. (1993). National and school policy. In *Foods for Children. Influencing Choice and Investing in Health*. A report of a conference on "Diet and Schoolchildren" organised by the National Forum for Coronary Heart Disease Prevention, pp. 30-37.
- Leather, S. (1997). Reaching the recommendations. What are the barriers? Chapter 2 in I.Sharp (ed.) *At Least Five a Day. Strategies to Increase Vegetables and Fruit Consumption*. National Heart Forum. The Stationery Office, London, pp.35-44.
- Lowe, C.F., Dowey, A. and Horne, P. (1998). Changing what children eat. Chapter 4 in A. Murcott (ed.) *The Nation's Diet. The Social Science of Food Choice*. Addison Wesley Longman, Ltd., Harlow, pp. 57-80.
- Lund, B.K., Gregson, K., Neale, R.J. and Tilston, C.H. (1990). Dietary awareness of children: specific food items. *British Food Journal*, 3, 28-31.
- MacFie, H.J.H. and Hedderley, D. (1993). Current practice in relating sensory perception to instrumental measurements. *Food Quality and Preference*, 4, 41-49.
- Maga, J.A. (1974). Influence of color on taste thresholds. *Chemical Senses Flavour*, 1, 115-119.
- Marshall, D., Anderson, A.S., Lean, M. and Foster, A. (1994). Healthy eating: fruit and vegetables in Scotland. *British Food Journal*, 96 (7), 18-24.

McEwan, J.A. (1988). *Methodology and New Applications in Food Acceptance Research*. Ph.D. thesis, University of Reading, UK.

McEwan, J.A. (1996). Preference mapping for product optimization. Chapter 3 in T.Naes and E. Risvik (eds.) *Multivariate Analysis of Data in Sensory Science*. Elsevier Science B.V., Amsterdam, pp.71-102.

McEwan, J.A. and Hallett, E.M. (1990). *A Guide to the Use and Interpretation of Generalised Procrustes Analysis*. Statistical Manual No. 1. RA Project No. 138. Supported by the SEWG. The Campden Food and Drink Research Association. February.

McEwan, J.A. and Schlich, P. (1991/92). Correspondence analysis in sensory evaluation. *Food Quality and Preference*, 3, 23-36.

McEwan, J.A. and Thomson, D.M.H. (1989). The repertory grid method and preference mapping in market research. A case study on chocolate confectionery. *Food Quality and Preference*, 1 (2), 59-68.

McEwan, J.A., Colwill, J.S. and Thomson, D.M.H. (1989) the application of two free-choice profile methods to investigate the sensory characteristics of chocolate. *Journal of Sensory Studies*, 3, 271-286.

McEwan, J.A., Earchy, P.J. and Ducher, C. (1998). Preference Mapping: A Review. *Campden & Chorleywood Food Research Association Review No. 6*.

McFayden, S.C., Stiles, M.E., Berg, R.T. and Hawkins, M.H. (1973). Factors influencing consumer acceptance of meats. *Canadian Institute of Food Science and technology Journal*, 6 (4), 219-225.

Meilgaard, M., Civille, G.V. and Carr, B.T. (1991). *Sensory Evaluation Techniques*, Second Edition. CRC Press, London.

Meiselman, H.L. (1994). A measurement scheme for developing institutional products. Chapter 1 in H.J.H. MacFie and D.M.H. Thomson (eds.) *Measurement of Food Preferences*, Blackie Academic and Professional, Glasgow, pp. 1-24.

Michela, J.L. and Contento, I.R. (1986). Cognitive, motivational, social and environmental influences on children's food choices. *Health Psychology*, 5 (3), 209-230.

Ministry of Agriculture, Fisheries and Food (MAFF) (1994). *The Dietary and Nutritional Survey of British Adults – Further Analysis*. HMSO, London.

Ministry of Agriculture, Fisheries and Food (MAFF) (1995). *National Food Survey 1994. Annual Report on Food Expenditure, Consumption and Nutrient Intakes*. HMSO, London.

Ministry of Agriculture, Fisheries and Food (MAFF) (1996). *National Food Survey 1995. Annual Report on Food Expenditure, Consumption and Nutrient Intakes*. HMSO, London.

Ministry of Agriculture, Fisheries and Food (MAFF) (1997). *National Food Survey 1996. Annual Report on Food Expenditure, Consumption and Nutrient Intakes*. HMSO, London.

Ministry of Agriculture, Fisheries and Food (MAFF) (1998). *National Food Survey 1997. Annual Report on Food Expenditure, Consumption and Nutrient Intakes*. HMSO, London.

Mullan, L.M., Holton, E.E. and Vickers, Z.M. (1996). Preference for and consumption of fat-free and full-fat cheese by children. *Journal of the American Dietetic Association*, 96 (6), 603-604.

Munoz, A.M. and Civile, G.V. (1987). Factors affecting perception and acceptance of food texture by American consumers. *Food Reviews International*, 3, 285-322.

Moskowitz, H.R. (1994). Children versus adults. Chapter 7 in *Food Concepts & Products. Just-in-Time Development*. Food & Nutrition Press Inc., Connecticut, pp. 293-331.

Naes, T. and Risvik, E. (1996). *Multivariate Analysis of Data in Sensory Science*, Elsevier Science B.V., Amsterdam.

National Academy of Sciences Committee on Diet, Nutrition and Cancer (1982). Assembly of Life Sciences, National Research Council. *Diet, Nutrition and Cancer*. Washington DC: National Academy Press.

National Children's Home (1991). *Poverty & Nutrition Survey*. NCH, London.

National Food Alliance (1997). *Myths about Food and Low Income*. A National Food Alliance Food Poverty Project. National Food Alliance, London.

National Heart Forum (1997a). *Preventing Coronary Heart Disease. The Role of Antioxidants, Vegetables and Fruit*. National Heart Forum. The Stationery Office, London.

National Heart Forum (1997b). *At Least Five a Day: Strategies to Increase Vegetable and Fruit Consumption*. National Heart Forum. The Stationery Office, London.

National Research Council (1989). Committee on Diet, Health, Food and Nutrition Board. National Research Council (US). *Diet and Health: Implications for Reducing Chronic Disease Risk*. National Academy Press, Washington DC.

Neale, R.J., Otte, S. and Tilston, C.H. (1995). Fruit: comparisons of consumption, attitudes, knowledge and preferences of primary school children in England and Germany. *Journal of Consumer Studies and Home Economics*, 19, 261-276.

Noronha, R.L., Damasio, M.H., Pivatto, M.M. and Negrillo, B.G. (1995). Development of attributes and panel screening for texture descriptive analysis of milk gels aided by multivariate statistical procedures. *Food Quality and Preference*, 6, 49-54.

Nuki, P. (1997). Fun-flavoured vegetables go down a treat. *The Sunday Times*, 13 April, p5.

Oreskovich, D.C., Klein, B.P. and Sutherland, J.W. (1991). Procrustes analysis and its application to free-choice and other sensory profiling. Chapter 13 in H.T. Lawless and B.P. Klein (eds.) *Sensory Science: Theory and Application in Foods*. Marcel Dekker, Inc., New York, pp. 353-393.

Pelchat, M.L. and Pliner, P. (1986). Antecedents and correlates of feeding problems in young children. *Journal of Nutrition Education*, 18, 23-29.

Piacentini, M.G. (1998). *Modelling Fruit And Vegetable Consumption: A Comparative Study Of Two Cities With High And Low Consumption*. Ph.D. thesis, Queen Margaret College, Edinburgh, UK.

Piaget, J. (1952). *The Origins of Intelligence in Children*, International Press, New York.

Piggott, J.R. (1986). *Statistical Procedures in Food Research*. Elsevier Applied Science, London.

Piggott, J.R. and Sharman, K. (1986). Methods to aid interpretation of multidimensional data. Chapter 6 in J.R. Piggott (ed.) *Statistical Procedures in Food Research*. Elsevier Applied Science, London. pp. 181-232.

Piggott, J.R. and Watson, M.P. (1992). A comparison of free-choice profiling and the repertory grid method in the flavor profiling of cider. *Journal of Sensory Studies*, 7 (2), 133-145.

Piggott, J.R., Sheen, M.R. and Guy, C. (1989). Bridging the gap between laboratory flavour research and the consumer. In G. Charalambous (ed.) *Flavours and Off-Flavours*. Proceedings of the 6th International Flavour Conference. Elsevier Science Publishers, B.V. Amsterdam, pp. 543-552.

Pliner, P. (1982). The effects of mere exposure on liking for edible substances. *Appetite*, 3, 283-290.

Pliner, P. (1983). Family resemblance in food preferences. *Journal of Nutrition Education*, 15, 137-140.

Pliner, P. and Loewen, E.R. (1997). Temperament and food neophobia in children and their mothers. *Appetite*, 28 (3) 227-238.

Powers, J.J. (1984). Current practices and application of descriptive methods. Chapter 7 in J.R. Piggott (ed.) *Sensory Analysis of Foods*, Elsevier Applied Science, London. Pp. 179-242.

PsychLit. CD-ROMs (1987-present). IFIS Publishing. Silver Platter International N.V.

Raats, M.M. and Shepherd, R. (1991/2). An evaluation of the use and perceived appropriateness of milk using the repertory grid method and 'item by use' appropriateness method. *Food Quality and Preference*, 3, 89-100.

Ravenette, A.T. (1977). Personal construct theory: an approach to the psychological investigation of children and young people. Chapter 11 in D. Bannister (ed.) *New Perspectives in Personal Construct Theory*, Academic Press Inc., London, pp.251-280.

Reicks, M., Randall, J.L. and Haynes, B.J. (1994). Factors affecting consumption of fruit and vegetables by low-income families. *Journal of the American Dietetic Association*, 94 (11), 1309-1311.

Retail Business (1997a). *Market Surveys: Fresh Fruit and Vegetables. Part 1*. No. 469, March, pp.8-30.

Retail Business (1997b). *Market Surveys: Fresh Fruit and Vegetables. Part 2*. No. 470, April, pp.14-46.

Robson, C. (1993). *Real World Research*. Blackwell, Oxford.

Rogers, P.J. and Mela, D.J. (1992). Biology and the senses. Do you eat what you like or like what you eat? Chapter 2 in *Your Food: Whose Choice?* National Consumer Council. HMSO, London, pp. 26-36.

Rose, R. and Falconer, P. (1992). Individual taste or collective decision? Public policy on school meals. *Journal of Social Policy*, 21 (3), 349-373.

Ross, S. (1995). 'Do I really have to eat that?' A qualitative study of schoolchildren's food choices and preferences. *Health Education Journal*, 54, 312-321.

Rousseau, N. (1983). "Give us a playpiece please, not lectures!" *Journal of the Royal Society of Health*, 103 (3), 104-111.

Rozin, P. (1982). Human food selection: the interaction of biology, culture and individual experience. In L.M. Barker (ed.) *The Psychobiology of Human Food Selection*. Ellis Horwood, Chichester, pp. 225-254.

Rozin, P. (1984). The acquisition of food habits and preferences. In J.D. Matarazzo, S.M. Weiss, J.A. Herd and N.E. Miller (eds.) *Behavioral Health: A Handbook of Health Enhancement and Disease Prevention*, Wiley: New York, pp.590-607.

Rozin, p. (1990). Development in the food domain. *Developmental Psychology*, 26, 555-562.

Rozin, P. (1991). Family resemblance in food and other domains: the family paradox and the role of parental congruence. *Appetite*, 16, 93-102.

Rozin, P., Fallon, A. and Mandell, R. (1984). Family resemblance in attitudes to foods. *Developmental Psychology*, 20 (2), 309-314.

Ruxton, C.H.S., Kirk, T.R. and Belton, N.R. (1996). The contribution of specific patterns to energy and nutrient intake in 7-8-year-old Scottish schoolchildren. III. Snacking habits. *Journal of Human Nutrition and Dietetics*, 9, 1-9.

Sacks, F.M. (1998). Scientific basis of the healthy Mediterranean diet. *Australian Journal of Nutrition and Dietetics*, December, 55 (4), S4-S7.

Salmon, P. (1976). Grid Measures with Child Subjects. Chapter 2 in P.Slater (ed.) *Explorations of Intrapersonal Space, Vol I*. John Wiley & Son, London.

Save the Children (1997). *Out of the Frying Pan: The true Cost of Feeding a Family on a Low Income*. Save the Children, London.

Scottish Office Department of Health (1999). *Towards a Healthier Scotland*. A White Paper on Health. February. The Stationery Office: Edinburgh.

Scottish Office Home and Health Department (1993). *Scotland's Health; A Challenge To Us All. The Scottish Diet Report*. Report of a Working Party to the Chief Medical Officer for Scotland. The Scottish Office. HMSO: Edinburgh.

Scriven, F.M., Gains, N., Green, S.R. and Thomson, D.M.H. (1989). A contextual evaluation of alcoholic beverages using the repertory grid method. *International Journal of Food Science and Technology*, 24, 173-182.

Shepherd, R. (1985). Dietary salt intake. *Nutrition & Food Science*, 96, 10-11.

Shepherd, R. (1990). Attitudes and beliefs as determinants of food choice Chapter 7 in R.L. McBride and H.J.H. MacFie (eds.) *Psychological Basis of Sensory Evaluation*, Elsevier Applied Science, London, pp.141-161.

Shepherd, R. (1995). Psychological aspects of food choice. *Food Science and Technology Today*, 9 (3), 178-182.

Shepherd, R. and Sparks, P. (1992). Culture, identity and psychology. Eating what others eat. Chapter 3 in *Your Food: Whose Choice?*. The National Consumer Council. HMSO, London, pp.37-48.

Shepherd, R. and Sparks, P. (1994). Modelling food choice. Chapter 8 in H.J.H. MacFie and D.M.H. Thomson (eds) *Measurement of Food Preferences*, Blackie Academic & Professional, Glasgow, pp.202-226.

Shepherd, R., Paisley, C.M., Sparks, P., Anderson, A.S., Eley, S. and Lean, M.E.J. (1996). Constraints on dietary choice: the role of income. *Nutrition & Food Science*, 5, 19-21.

Schiffman, S.S., Reynolds, L.M. and Young, F.W. (1981). *Introduction to Multidimensional Scaling*, Academic Press, New York.

Social Sciences Citation Index CD-ROMs (1981 to present). Institute for Scientific Information®, Inc.

SPSS Inc. (1994a). Non-linear principal components analysis. Chapter 9 in *SPSS Categories® 6.1*, SPSS Inc: Chicago, pp. 79-93.

SPSS Inc. (1994a). Homogeneity analysis. Chapter 8 in *SPSS Categories® 6.1*, SPSS Inc: Chicago, pp. 65-78.

Stafford, H. (1995). *Progress Report: Evaluation of Phase II of the Victorian 2 Fruit 'n' 5 Veg Every day Campaign*. Victoria: Food and Nutrition Program, Deakin University, Australia.

Stead, M. and Goodlad, N. (1996). *Promoting Consumption of Vegetables: A Qualitative Exploratory Study of Women's Knowledge, Attitudes and Practice*. Centre for Social Marketing, University of Strathclyde.

Steenkamp, J-B.E.M. and Van Trijp, H.C.M. (1988). Free-choice profiling in cognitive food acceptance research. Chapter 27 in D.M.H. Thomson (ed) *Food Acceptability*, Elsevier Applied Science, London, pp363-376.

Steiner, J.E. (1977). Facial expressions of the neonate infant indicating the hedonics of food-related chemical stimuli. In J.M. Weiffenbach (ed) *Taste and Development*, US Department of Health and Welfare, Bethesda.

Sullivan, S. and Birch, L.L. (1990). Pass the sugar: Pass the salt: Experience dictates preference. *Developmental Psychology*, 26, 546-551.

Szczesniak, A.S. (1963). Classification of textural characteristics. *Journal of Food Science*, 28, 385.

Szczesniak, A.S. (1971). Consumer awareness of texture and other food attributes. *Journal of Texture Studies*, 2 (2), 196-206.

Szczesniak, A.S. (1972). Consumer awareness of and attitudes to food texture. II: Children and teenagers. *Journal of Texture Studies*, 3, 206-217.

Szczesniak, A.S. (1979). Recent developments in solving consumer-orientated texture problems. *Food technology*, 33, 61-66.

Szczesniak, A.S. (1987). Relationship of texture to food acceptance and nutrition. In J.Solms, D.A. Booth, R.M. Pangborn and O. Raunhardt (eds.) *Food Acceptance and Nutrition*, Academic Press Ltd: London, pp. 157-172.

Szczesniak, A.S. and Kleyn, D.H. (1963). Consumer awareness of texture and other food attributes. *Food Technology*, 17, 74.

Szczesniak, A.S. and Kahn, E.L. (1972). Consumer awareness of and attitudes to food texture. I. Adults. *Journal of Texture Studies*, 2, 280-295.

Szczesniak, A.S. and Skinner, E.Z. (1973). Meaning of texture words to the consumer. *Journal of Texture Studies*, 4 (3), 378-384.

Szczesniak, A.S., Loew, B.J. and Skinner, E.Z. (1975). Consumer Texture Profile technique. *Journal of Food Science*, 40, 1253-1255.

Tepper, B.J. (1999). Does genetic taste sensitivity to PROP influence food preferences and body weight? *Appetite*, 32, 422 (abstract only).

Thomson, D.M.H. and McEwan, J.A. (1988). An application of the repertory grid method to investigate consumer perceptions of foods. *Appetite*, 10, 181-193.

Ton Nu, C., MacLeod, P. and Barthelemy, J. (1996). Effects of age and gender on adolescents' food habits and preferences. *Food Quality and Preference*, 7 (3/4), 251-262.

Tunstall-Pedoe, H., Smith, W.C.S., Crombie, I.K. and Tavendale, R. (1989). Coronary risk factor and lifestyle variation across Scotland: Results from the Scottish Heart Health Study. *Scottish Medical Journal*, 34, 556-560.

United States department of Health and Human Services (1991). *Healthy People 2000: National Promotion and Disease Prevention Objectives*. DHHS (PHS) Publication No. DHS-91-50213. Washington DC: US Government Printing Office.

Van Toller, S. (1994). Psychology and psychobiological measurements of flavour. In J.R. Piggott and A. Paterson (eds.) *Understanding Natural Flavours*, Blackie Academic and Professional, Glasgow, p.48.

Walker, M.A., Hill, M.M. and Millman, F.D. (1973). Fruit and vegetable acceptance by students. *Journal of the American Dietetic Association*, 62, 268-271.

Walsh, L.M., Toma, R.B., Tuveson, R.V. and Sondhi, L. (1990). Color preference and food choice among children. *Journal of Psychology*, 124 (6), 645-653.

Wardle, J. (1995). Parental influences on children's diets. *Proceedings of the Nutrition Society*, 54, 747-758.

Williams, A.A. and Arnold, G.M. (1985). A comparison of the aromas of six coffees characterised by conventional profiling, free-choice profiling and similarity scaling. *Journal of the Science of Food and Agriculture*, 36, 204-214.

Williams, C. (1997). Recommended and current consumption patterns: how big is the gap? Chapter 1 in the National Heart Forum *Strategies to Increase Vegetable and Fruit Consumption*, The Stationery Office, London, pp. 19-34.

Williams, C. and Ward, P. (1993). *School Meals: Report of a Survey of Parents' Attitudes to the School Meals Service and Weekday Dietary Habits of School Children in Seven Case Study Schools*. Consumers' Association: London.

World Health Organisation (1982). *Prevention of Coronary Heart Disease: Report of a WHO Expert Committee*. WHO technical report Series 1982 (678). Geneva: World Health Organisation.

World Health Organisation (1990). *Diet, Nutrition and the Prevention of Chronic Diseases*. Technical Report Series 797. Geneva: World Health Organisation.

World Health Organisation (1999). Major cardiovascular study shows substantial regional differences. Press release, 7 May 1999. Available on the internet at: <http://www.who.int/inf-pr-1999/en/pr99-27.html>.

Worsley, A. (1980). Thought for food: investigations of cognitive aspects of food. *Ecology of Food and Nutrition*, 9, 65-80.

Worsley, A., Baghurst, P., Worsley, A.J., Coonan, W. and Peters, M. (1984a). Australian ten year olds' perceptions of food. I: Sex differences. *Ecology of Food and Nutrition*, 15, 213-246.

Worsley, A., Baghurst, P., Worsley, A.J., Coonan, W. and Peters, M. (1984b). Australian ten year olds' perceptions of food. II: Social status effects. *Ecology of Food and Nutrition*, 15, 247-257

Wrieden, W. (1996). Fruit and vegetable consumption of 10-11-year-old-children in a region of Scotland. *Health Education Journal*, 55 (2), 185-193..

Wrieden, W.L. and Bürger, I. (1998). Acceptability and nutritional comparison of flavoured vegetables. *British Food Journal*, 100 (7), 337-342.

Wrieden, W. and Moore, E.J.H. (1995). The dietary habits of 11-12-year-old children in two Tayside secondary schools – comparison with the targets set by the Scottish Diet Report. *Health Bulletin*, 53 (5) 299-306.

Wrieden, M., Bolton-Smith, C., Brown, C. and Tunstall-Pedoe, H. (1993). Fruit and vegetable consumption on North Glasgow: some results from the MONICA study of 1986 and 1989. *Proceedings of the Nutrition Society*, 52, 12A.

Worsley, A., Baghurst, P., Worsley, A.J., Coonan, W. and Peters, M. (1984b). Australian ten year olds' perceptions of food. II: Social status effects. *Ecology of Food and Nutrition*, 15, 247-257

Wrieden, W. (1996). Fruit and vegetable consumption of 10-11-year-old-children in a region of Scotland. *Health Education Journal*, 55 (2), 185-193..

Wrieden, W.L. and Bürger, I. (1998). Acceptability and nutritional comparison of flavoured vegetables. *British Food Journal*, 100 (7), 337-342.

Wrieden, W. and Moore, E.J.H. (1995). The dietary habits of 11-12-year-old children in two Tayside secondary schools – comparison with the targets set by the Scottish Diet Report. *Health Bulletin*, 53 (5) 299-306.

Wrieden, M., Bolton-Smith, C., Brown, C. and Tunstall-Pedoe, H. (1993). Fruit and vegetable consumption on North Glasgow: some results from the MONICA study of 1986 and 1989. *Proceedings of the Nutrition Society*, 52, 12A.

APPENDIX 1

APPENDIX 1

Demographic Details of the Assessors Participating in the Main Study

Assessor	City	Area ¹	Age (months)	Gender	Frequency of vegetable consumption (times/week)
1	Glasgow	1	116	F	7
2	Glasgow	1	106	F	4
3	Glasgow	1	107	M	7
4	Glasgow	1	112	F	7
5	Glasgow	1	116	M	4
6	Glasgow	1	108	M	7
7	Glasgow	1	108	F	7
8*	Glasgow	1	111	F	4
9	Glasgow	1	110	M	Not provided
10	Glasgow	1	112	F	4
11	Glasgow	1	117	M	7
12	Glasgow	1	115	M	4
13	Glasgow	1	113	M	7
14	Glasgow	1	115	F	4
15	Glasgow	1	112	F	7
16	Glasgow	1	116	F	7
17	Glasgow	1	121	M	4
18	Glasgow	1	107	M	3
19	Glasgow	1	111	M	7
20	Glasgow	1	107	F	7
21	Glasgow	1	115	M	4
22	Glasgow	1	116	F	4
23	Glasgow	1	108	M	7

*Note: Area¹ : 1 = advantaged, 7 = disadvantaged(refers to deprivation category scores).
Assessor's data incomplete, therefore not used in analysis*

Assessor	City	Area ¹	Age (months)	Gender	Frequency of vegetable consumption (times/week)
24	Glasgow	7	101	M	3
25	Glasgow	7	108	M	4
26	Glasgow	7	106	F	4
27	Glasgow	7	99	M	1
28	Glasgow	7	119	F	4
29	Glasgow	7	115	F	7
30	Glasgow	7	108	M	4
31	Glasgow	7	117	M	0
32	Glasgow	7	123	F	3
33	Glasgow	7	112	M	7
34	Glasgow	7	120	M	3
35	Glasgow	7	116	M	1
36	Glasgow	7	121	F	1
37*	Glasgow	7	110	M	4
38	Glasgow	7	105	F	4
39	Glasgow	7	112	F	7
40	Glasgow	7	116	M	0
41	Glasgow	7	112	M	1
42	Glasgow	7	114	F	1
43	Glasgow	7	112	F	3
44	Glasgow	7	113	F	7

*Note: Area¹: 1 = advantaged, 7 = disadvantaged(refers to deprivation category scores).
Assessor's data incomplete, therefore not used in analysis*

Assessor	City	Area ¹	Age (months)	Gender	Frequency of vegetable consumption (times/week)
45	Edinburgh	7	111	M	Not provided
46	Edinburgh	7	100	F	1
47	Edinburgh	7	100	F	4
48	Edinburgh	7	105	F	Not provided
49	Edinburgh	7	104	M	4
50	Edinburgh	7	110	F	Not provided
51	Edinburgh	7	100	M	3
52	Edinburgh	7	107	F	4
53	Edinburgh	7	108	M	4
54	Edinburgh	7	110	F	4
55	Edinburgh	7	106	F	4
56	Edinburgh	7	103	F	Not provided
57	Edinburgh	7	104	M	4
58	Edinburgh	7	100	F	7
59	Edinburgh	7	109	F	7
60	Edinburgh	7	125	M	Not provided
61	Edinburgh	7	106	M	7
62	Edinburgh	7	106	F	4
63	Edinburgh	7	104	M	4
64	Edinburgh	7	114	F	4
65	Edinburgh	7	102	F	4
66	Edinburgh	7	108	F	7
67	Edinburgh	7	111	F	3
68	Edinburgh	7	119	M	4
69	Edinburgh	7	110	F	3

*Note: Area¹ : 1 = advantaged, 7 = disadvantaged(refers to deprivation category scores).
Assessor's data incomplete, therefore not used in analysis*

Assessor	City	Area ¹	Age (months)	Gender	Frequency of vegetable consumption (times/week)
70	Edinburgh	1	106	M	7
71	Edinburgh	1	107	M	3
72	Edinburgh	1	105	M	3
73	Edinburgh	1	110	F	4
74	Edinburgh	1	108	F	7
75	Edinburgh	1	108	M	3
76	Edinburgh	1	105	F	4
77*	Edinburgh	1	108	M	Not provided
78	Edinburgh	1	106	F	7
79	Edinburgh	1	98	M	4
80	Edinburgh	1	104	M	4
81	Edinburgh	1	98	M	3
82	Edinburgh	1	109	F	7
83	Edinburgh	1	106	M	3
84	Edinburgh	1	104	M	3
85	Edinburgh	1	104	F	4
86	Edinburgh	1	101	M	4
87	Edinburgh	1	105	F	7
88	Edinburgh	1	99	M	1
89	Edinburgh	1	101	M	3
90	Edinburgh	1	105	F	4
91	Edinburgh	1	106	F	4
92	Edinburgh	1	107	F	4
93	Edinburgh	1	108	F	1
94*	Edinburgh	1	105	M	Not provided

*Note: Area¹ : 1 = advantaged, 7 = disadvantaged(refers to deprivation category scores).
Assessor's data incomplete, therefore not used in analysis*

APPENDIX 2

Queen Margaret College

EDINBURGH



VEGETABLE CONSUMPTION QUESTIONNAIRE

Name: _____

Date-of-Birth: _____

This study is being conducted by:

*Irene Baxter
Department of Applied Consumer Studies
Queen Margaret College
Edinburgh
EH12 8TS*

Tel: (0131) 317 3454

VEGETABLE CONSUMPTION QUESTIONNAIRE

Please note: In this questionnaire, the term 'vegetables' can also include **baked beans** and **salads**. However, do **not** count **potatoes** as a vegetable.

1. How often do you eat vegetables?

Tick the most appropriate box

☐ Never

☐ Every day

☐ Once a week

If 'Once a week', do you only eat vegetables on a Sunday?

☐ Yes

☐ No

☐ 2-3 times a week

2.a. Do you have a favourite vegetable?

☐ Yes

☐ No

b. If you answered 'yes' to this, **what is your favourite vegetable?**

If you answered 'no', go to question 3.

My favourite vegetable is:

c. Why is it your favourite?

3.a. What is the vegetable you dislike the most?

b. Why don't you like this?

4. Do you eat vegetables at home?

☐ Yes

☐ No

If you answered 'no', please go to question 6.

5. At home, who decides which vegetables you are given to eat?

Please tick the appropriate box

☐ You

☐ Mother

☐ Father

☐ Other person. If so, who is this person? _____

6. Do you eat a school dinner?

☐ Yes

☐ No

If you answered 'no', go to question 8.

7. Do you have vegetables with your school dinner?

☐ Yes

☐ No

8. Which of these vegetables have you eaten? (*Tick the ones you have tried*)

- | | |
|--------------------------------------|----------------------------------|
| <input type="checkbox"/> Baked beans | <input type="checkbox"/> Turnip |
| <input type="checkbox"/> Carrot | <input type="checkbox"/> Celery |
| <input type="checkbox"/> Tomatoes | <input type="checkbox"/> Lettuce |
| <input type="checkbox"/> Broccoli | <input type="checkbox"/> Peas |
| <input type="checkbox"/> Cauliflower | <input type="checkbox"/> Cabbage |
| <input type="checkbox"/> Peppers | |

9. Are there any of these vegetables which you don't know of?

(Tick the ones you don't know)

- | | |
|--------------------------------------|----------------------------------|
| <input type="checkbox"/> Baked beans | <input type="checkbox"/> Turnip |
| <input type="checkbox"/> Carrot | <input type="checkbox"/> Celery |
| <input type="checkbox"/> Tomatoes | <input type="checkbox"/> Lettuce |
| <input type="checkbox"/> Broccoli | <input type="checkbox"/> Peas |
| <input type="checkbox"/> Cauliflower | <input type="checkbox"/> Cabbage |
| <input type="checkbox"/> Peppers | |

10. For the following pairs of vegetables, please show how suitable you think they are for eating together in the same meal:

e.g. *Cucumber and celery*

If you think these are very suitable for eating together, then tick that box:

- ☒ Very suitable
- ☐ Slightly suitable
- ☐ Not sure if suitable or unsuitable
- ☐ Slightly unsuitable
- ☐ Very unsuitable

How suitable do you think the following pairs of vegetables are for eating together?

	Very Suitable	Slightly Suitable	Not sure if suitable or unsuitable	Slightly Unsuitable	Very Unsuitable
<i>Baked Beans & Carrots</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Baked Beans & Tomatoes</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Baked Beans & Broccoli</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Baked Beans & Turnip</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Baked Beans & Celery</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

	Very Suitable	Slightly Suitable	Not sure if suitable or unsuitable	Slightly Unsuitable	Very Unsuitable
<i>Baked Beans & Lettuce</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Baked Beans & Peas</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Carrots & Tomatoes</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Carrots & Broccoli</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Carrots & Turnip</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Carrots & Celery</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Carrots & Lettuce</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Carrots & Peas</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Tomatoes & Broccoli</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Tomatoes and Turnip</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Tomatoes & Celery</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Tomatoes & Lettuce</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Tomatoes & Peas</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Broccoli & Turnip</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

	Very Suitable	Slightly Suitable	Not sure if suitable or unsuitable	Slightly Unsuitable	Very Unsuitable
<i>Broccoli & Celery</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Broccoli & Lettuce</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Broccoli & Peas</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Turnip & Celery</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Turnip & Lettuce</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Turnip & Peas</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Celery & Lettuce</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Celery & Peas</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Lettuce & Peas</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Thankyou very much for filling out this questionnaire!

Did you find this questionnaire easy to fill in, or was it too difficult?

Was there anything that you didn't understand?

Can you suggest any ways in which this could be made better?

APPENDIX 3

Queen Margaret College

EDINBURGH



VEGETABLE QUESTIONNAIRE

Name: _____

Date-of-Birth: _____

This study is being conducted by:

Irene Baxter

Department of Applied Consumer Studies

Queen Margaret College

Edinburgh

EH12 8TS

Tel: (0131) 317 3454

Please note: When answering this, 'Vegetables' also includes **baked beans** and **salads**. However, for this questionnaire, **potatoes** do **NOT** count as a vegetable.

1. How often do you eat vegetables?

Tick the most appropriate box

- ☐ Never (now go to question 2).
- ☐ Every day (now go to question 2).
- ☐ 4-6 times a week (now go to question 2).
- ☐ 2-3 times a week (now go to question 2).
- ☐ Once a week

- If you only eat vegetables 'Once a week', is it on a particular day ?

- ☐ No (now go to question 2).
- ☐ Yes

- If 'Yes', you only eat vegetables on one particular day, which day is it?

Tick the appropriate box for the day of the week

- ☐ Sunday
- ☐ Monday
- ☐ Tuesday
- ☐ Wednesday
- ☐ Thursday
- ☐ Friday
- ☐ Saturday

- Why do you eat vegetables only on this day?

REMEMBER: POTATOES DO NOT COUNT AS A VEGETABLE FOR THIS, BUT BAKED BEANS AND SALADS CAN BE INCLUDED !!

2.a. Do you have a favourite vegetable?

Tick the appropriate box

☐ Yes

☐ No (now go to question 3).

b. If you answered 'yes' to this, what is your favourite vegetable?

My favourite vegetable is:

c. Why is it your favourite?

3.a. What is the vegetable you dislike the most?

b. Why don't you like this?

REMEMBER: POTATOES DO NOT COUNT AS A VEGETABLE FOR THIS, BUT BAKED BEANS AND SALADS CAN BE INCLUDED !!

4. Do you eat vegetables at home?

- ☐ Yes (please go to question 5).
- ☐ No (please go to question 6).

5. At home, who decides which vegetables you are given to eat?

Please tick all the boxes which apply

- ☐ You
- ☐ Mother
- ☐ Father
- ☐ Other person. If so, who is this person?

6. Do you eat a school dinner?

- ☐ Yes (now go to question 7).
- ☐ No (now go to question 8).

7. Do you have vegetables with your school dinner?

- ☐ Yes
- ☐ No

8. Which of these vegetables have you eaten? (Tick the ones you have tried)

- | | |
|--------------------------------------|-----------------------------------|
| <input type="checkbox"/> Baked beans | <input type="checkbox"/> Turnip |
| <input type="checkbox"/> Cauliflower | <input type="checkbox"/> Cabbage |
| <input type="checkbox"/> Sweetcorn | <input type="checkbox"/> Peas |
| <input type="checkbox"/> Carrots | <input type="checkbox"/> Tomatoes |

9. Are there any other vegetables which you have eaten? If YES, which?

10. Are there any of these vegetables which you don't know of?
(Tick the ones you don't know)

- | | |
|--------------------------------------|------------------------------------|
| <input type="checkbox"/> Baked beans | <input type="checkbox"/> Turnip |
| <input type="checkbox"/> Cauliflower | <input type="checkbox"/> Cabbage |
| <input type="checkbox"/> Peas | <input type="checkbox"/> Sweetcorn |
| <input type="checkbox"/> Carrots | <input type="checkbox"/> Tomatoes |

PLEASE TURN OVER THE PAGE

11. Do you like these vegetables? (*Yes/No/Don't know*). Please explain why.

a. Baked beans *Yes/No/Don't know*
because.....

b. Cauliflower *Yes/No/Don't know*
because.....

c. Sweetcorn *Yes/No/Don't know*
because.....

d. Carrots *Yes/No/Don't know*
because.....

11....continued Do you like these vegetables? (Yes/No/Don't know).
Please explain why.

e. Turnip Yes/No/Don't know
because.....

f. Cabbage Yes/No/Don't know
because.....

g. Peas Yes/No/Don't know
because.....

h. Tomatoes Yes/No/Don't know
because.....

12. Where do your family go to buy vegetables ?*Tick the ones used*

- ☐ Supermarket
- ☐ Greengrocer
- ☐ Local corner shop
- ☐ Other. If so, where? _____

PLEASE TURN OVER THE PAGE

13. In the table below, please show how nice you think the vegetables listed would be to eat with the foods shown. Please put the right code (0, 1, 2, 3 and DK) into the appropriate box in the table.

- 0
1
2
3
DK
- Would be really horrible together*
Would not be very nice together
Would be quite nice together
Would be really nice together
Don't know

	Chicken	Sausages or Bacon	Burgers	Red meat (Pork, ham, lamb, beef)	Soups	Stews	Pies	Fish	Cooked breakfast
Cauliflower									
Carrots									
Baked Beans									
Sweetcorn									
Tomatoes									
Turnip									
Cabbage									
Peas									

Thankyou very much for filling in this questionnaire !!